



MPHIL

Understanding the market segmentation process in a small engineering company

Cheng, Lindsay

Award date:
2007

Awarding institution:
University of Bath

[Link to publication](#)

Alternative formats

If you require this document in an alternative format, please contact:
openaccess@bath.ac.uk

Copyright of this thesis rests with the author. Access is subject to the above licence, if given. If no licence is specified above, original content in this thesis is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC-ND 4.0) Licence (<https://creativecommons.org/licenses/by-nc-nd/4.0/>). Any third-party copyright material present remains the property of its respective owner(s) and is licensed under its existing terms.

Take down policy

If you consider content within Bath's Research Portal to be in breach of UK law, please contact: openaccess@bath.ac.uk with the details. Your claim will be investigated and, where appropriate, the item will be removed from public view as soon as possible.

Understanding the market segmentation process in a small engineering company

Submitted by Lindsay Cheng

A thesis submitted for the degree of MPhil
University of Bath
School of Management

September 2007

COPYRIGHT

Attention is drawn to the fact that copyright of this thesis rests with its author. A copy of this thesis has been supplied on condition that anyone who consults it is understood to recognise that its copyright rests with the author and they must not copy it or use material from it except as permitted by law or with the consent of the author.

This thesis may be made available for consultation within
the University Library and may be photocopied or lent to other libraries
for the purposes of consultation.

Signed:


Contents

	Page no.
Abstract	i
Acknowledgements	ii
Introduction	iii
Chapter 1	Background and research problem
1.1	Company history
1.2	Company structure
1.3	Company services and skills
1.4	Eatec's marketing efforts
1.5	Understanding Eatec's market sectors
1.6	Summary to chapter 1
Chapter 2	Literature review
2.1	Why do managers segment markets?
2.2	Difficulties in business-to-business segmentation
2.3	Business-to-Business segmentation: models and theories
2.4	Conclusion
Chapter 3	Research Methodology
3.1	Research Introduction
3.2	Justification of chosen research methodology
3.3	Planning of research design
3.4	Research success factors
3.5	Data collection methodology
3.6	Communication and analysis of data
Chapter 4	Segmentation process
4.1	Introduction to the primary research
4.2	Before segmentation
4.3	Segmentation process
Chapter 5	Research findings and learning points
5.1	Understanding the 'Before segmentation' stage
5.2	Understanding the 'Segmentation process'
5.3	Researcher influence and learning
5.4	Summary
Chapter 6	Conclusions and Recommendations
6.1	Research conclusions
6.2	Suggestions for further research
6.3	Industrial recommendations
Bibliography	100
Appendices	
1	SWOT and PEST analysis
2	Market sector reports
3	Segmentation implementation study

Content of Tables

1.1	Eatec's in-house engineering skills	3
1.2	Eatec's industries	3
1.3	Competitor analysis	7
2.1	Comparing and contrasting academic and practitioner priorities in segmentation research	14
2.2	Micro-variables within macro-variables, illustrating Wind and Cardozo 's (1974) theory	15
2.3	Segmentation criteria, definitions and scales (Palmer and Millier, 2004)	31
2.4	Summary of segmentation models and frameworks	36
3.1	Different types of workplace research and its contributions (Reason and Rowan, 1981)	40
3.2	Elements of participant observation (DeWalt and DeWalt, 2002)	44
4.1	Company objectives	51
4.2	Exploratory market research brief and questions developed	58
4.3	Attributes agreed by directors	61
4.4	The attribute weights	62
4.5	JAS pilot results	64
4.6	JAS results for 3 services - average scores for the highest ranked markets	68
4.7	JAS results for all services summed to give rank of market sectors	68
4.8	8x8 matrix for revised judgmental modeling approach	70
4.9	The sum of all three director's scores of the 8x8 matrix analysis	71
4.10	Total scores per sector through revised judgemental modelling approach	72
4.11	Selected number of companies sort by region	76

Content of Figures

1.1	Organisational structure of Eatec Ltd	2
1.2	Eatec services	2
1.3	Eatec's market sectors (1999-2001)	5
1.4	Eatec's market sectors (2000-2001)	5
2.1	Macro-micro model of industrial market segmentation (Wind and Cardozo, 1974)	16
2.2	Five-layered nested model (Bonoma and Shapiro, 1984)	17
2.3	The road to a needs based segmentation (Hague, 2002)	18
2.4	The stages of segmentation (Dibb and Simkin, 1997)	22
2.5	A Segmentation Selection Process (Freytag and Clarke, 2001)	24
2.6	An integrating framework of business segmentation (Goller et al., 2002)	25
2.7	Segmentation data capture (Palmer and Millier, 2004)	32
3.1	Kolb's Learning Cycle (1984)	42
4.1	Figure 4.1. Eatec's strategic marketing plan in alignment with Goller et al. (2002) integrated framework of segmentation	49
4.2	The Decision Matrix	62
4.3	Regional map used for subsequent segmentation	75
5.1	Stimulus-Outcome model of segmentation decision making process (source: adapted from Kotler, 1992)	84
5.2	Researcher's experiential learning using Kolb's learning cycle (1984)	89

Abstract

The research follows the development of a strategic marketing and segmentation process in a small engineering company. Existing business-to-business segmentation literature demonstrates the necessity to balance diverse customer needs with the capabilities and resources of competing organisations in the marketplace, but there are also known problems associated with it.

The researcher was employed in Eatec for the duration of the two-year case study research. Action research was adopted to monitor the development of the strategic marketing planning and segmentation process. Whilst a structured approach to the strategic marketing and segmentation process was encouraged, the researcher demonstrated pitfalls in adopting a structured approach to the decision making process when evaluating and selecting market sectors.

Integrating all elements of marketing activities into one process was recognised to be important for success. The directors had previously used the notion of intuition in isolation. The introduction of a strategic marketing and segmentation plan encouraged the directors to use information gained from internal and external environmental analysis, as well as marketing intelligence to substantiate their 'gut-feel'. This led to the requirement for an appropriate evaluation and selection method which has to be intuitively appealing without it being too structured or restrictive.

At the individual level of each company, it is the defined company objectives and business strategies that determine the appropriate segmentation approach, but common elements exist to all companies. The researcher believes that a structured process helps to pull different tasks from different business areas together in one process. It is the balance of these elements that makes a segmentation process unique to each company.

The research concludes that segmentation activities should be integrated into a structured strategic marketing plan but the complex decision making process that happens during segmentation, in contrast should be less structured. By using multi-criteria decision making in a measured approach, the value of experience and intuition can be incorporated in conjunction with market intelligence when evaluating between equally favourable market sectors.

Acknowledgements

The researcher would like to acknowledge the following for their assistance and support in the duration of this research and thesis write up.

Mr B Williams, Director, Eatec Ltd

Mr B Jarvis, Director, Eatec Ltd

Mr N Wilcox, Director, Eatec Ltd

Mr J N Nicholls, Research Supervisor, University of Bath

Mr P Naudé, Academic Supervisor, University of Manchester

Mr A X Shi

Introduction

Business-to-business marketers have discussed in considerable detail in academic literature what segmentation is, and thoroughly justified why segmentation is important in marketing. However, there is a lack of practical guidance for the practitioner to understand how the task can actually be carried out in confidence, in particular the evaluation and selection of target markets. This study is related to the integrated process of strategic marketing planning and segmentation in a small engineering company. Particular attention was paid to the evaluation and selection process of market sectors and the integration of the Directors' intuition.

The researcher began employment as a marketing associate of a two-year knowledge transfer partnership between University of Bath, School of Management and Eatec Ltd, a small engineering company. The aim of the partnership was to develop new research knowledge into academia and vice versa to transfer knowledge into industry, in this case to assist Eatec on plans for growth. The researcher's role was to help implement a strategic marketing program. The company had previously made commitments to develop a strategic marketing plan but progress was slow due to lack of time and expertise in this field. The Directors felt that recruiting a non-engineer with a marketing background from the University of Bath, with access to the School of Management to serve as a knowledge pool for academic advice in the business-to-business marketing field, would assist in a fresh attempt to achieve a variety of marketing objectives.

During preliminary discussions, it was recognised that segmentation evaluation and selection would dominate the strategic marketing planning process. This was due to the lack of knowledge and guidance available to effectively carry out this task using a suitable measured approach. The researcher believed that immense value would be achieved academically by studying the development of the company's segmentation process.

The researcher used an action learning method. This is reflected in the thesis reporting format by highlighting learning points in core chapters. The framework and methodology for segmentation that was developed over the two years demonstrated the importance of allowing the Directors to utilise the notion of intuition and knowledge gained by years of experience in the engineering industry to evaluate and select target markets. So that the key research focus is not diluted, this thesis does not report on subsequent marketing activities following segmentation but the research material and implementation study is included within the appendix for further reference.

Chapter 1 provides a brief summary of the background to the company with the research problem identified.

Chapter 2 reviews the extant literature on business-to-business segmentation and highlights area that might contribute to this study.

Chapter 3 identifies the methodology chosen for the context being investigated with its appropriateness justified.

Chapter 4 presents the segmentation process. Findings are discussed within the context of the research method justified in chapter 3 and presented in relation to the research objective.

Chapter 5 is a discussion on the findings and key learning points presented in relation to the researcher's experience.

Chapter 6 concludes how the research problem has been addressed, illustrating contributions to theory with further research and industrial recommendations.

The aims of this research are:

To record the progress of the development of the segmentation framework in the case company, paying particular attention to how the Directors selected and evaluated market sectors.

Chapter 1

Background and research problem

This MPhil research was carried out in Eatec Ltd, a small engineering company between the months January 2002 to December 2003. The first chapter provides an introduction and background to the company. The problem identified was that of marketing strategy implementation in a small business-to-business firm, with a particular emphasis on how segmentation strategy should be integrated into this. This sets the scene for the establishment of the research to focus on segmentation. The challenges of segmentation in a business-to-business context were investigated through action research.

1.1 Company history

Eatec Ltd is an independent UK company, which specialises in the provision of high technology engineering services to clients in the Mechanical Engineering industry. Eatec's clients are involved in the development of new products, resolution of engineering problems, or undertaking research. Eatec Ltd has positioned itself as a 'first rate' consultancy service that seeks not just to identify client problems, but to follow projects through until the best solution is found.

The company was formed through a management buy-out of the analysis and testing consultancy group of Pafec Ltd. Pafec Ltd was set up as a commercial company following the growth of a research group into Finite Element Analysis at Nottingham University. Pafec Ltd opened an office in Bristol in 1980 to support the work it was undertaking for the Ministry of Defence in Weymouth.

Pafec Ltd diversified into other areas of engineering such as Computer Aided Design (CAD) and Data Management, and grew significantly. The consultancy work did not grow at the same rate as other areas of the business. Four employees undertook a management buy-out of this area of the company and Eatec Ltd began trading in 1991. Eatec Ltd provided services primarily in Finite Element Analysis and Dynamic Testing.

1.2 Company structure

In the past few years there has been a degree of fluctuation in the number of employees at Eatec due to the trend in the engineering industry for engineers to opt for contract work. At the time of study, Eatec had 11 professional engineers with specialist skills. The organisational chart (figure 1.1) shows each person's qualifications and expertise.

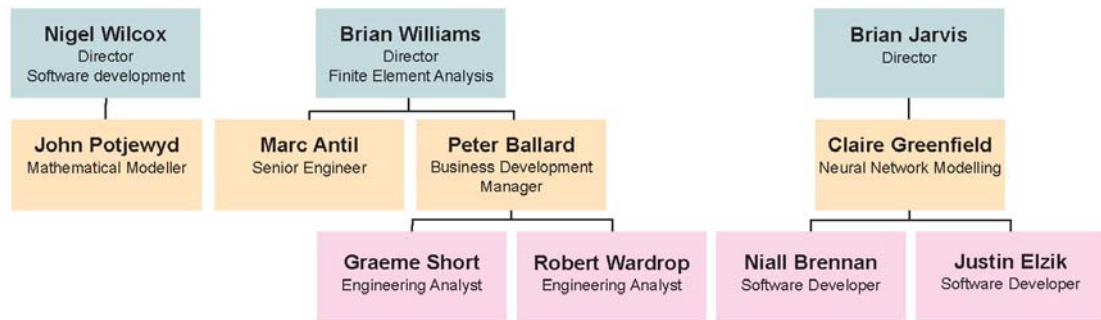


Figure 1.1. Organisational structure of Eatec Ltd

This structure is not rigid or formalised and there was a degree of 'cross-over' as deemed necessary by certain projects.

1.3 Company services and skills

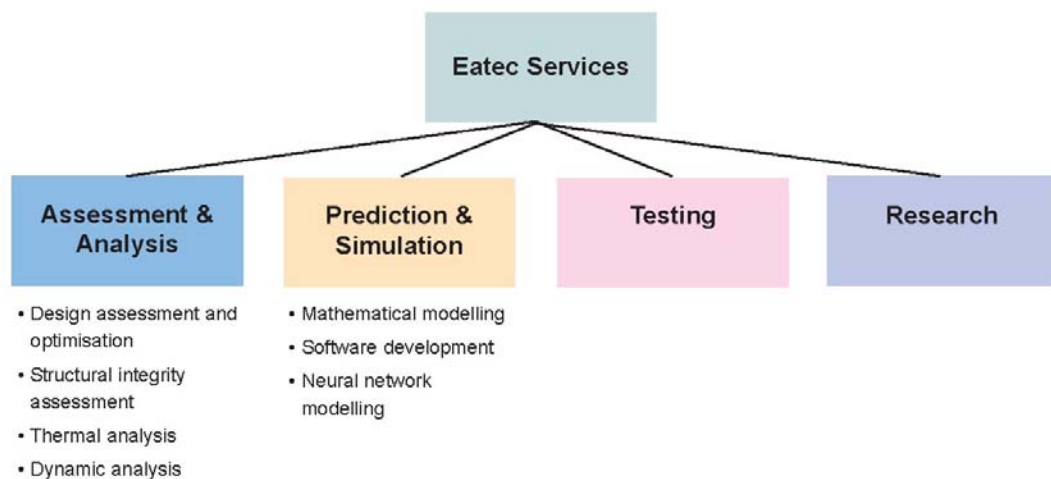


Figure 1.2. Eatec services

Eatec specialises in providing engineering services to clients who are engaged in the development of new products, resolution of engineering problems, or are undertaking research. The services provided by Eatec are outlined in figure 1.2. Eatec's in-house skills to provide the engineering services are listed in table 1.1.

Eatec in-house skills	
1	Finite element analysis (FEA)
2	Structural integrity
3	Computational fluid dynamics (CFD)
4	Testing
5	Mathematical modelling & simulation
6	Data handling

Table 1.1. Eatec's in-house engineering skills

Eatec's services are offered to a diverse range of clients who operate across different industries. The industries that Eatec operate in most frequently are listed in table 1.2.

Eatec operates predominantly within the following industries:	
1	Transport
2	Defence
3	Power
4	Oil and Gas
5	Marine
6	Aerospace
7	Industrial

Table 1.2. Eatec's industries

As the services (figure 1.2) and skills (table 1.1) offered by Eatec can be applied across many market sectors, such complexities make it difficult for Eatec to select and target just one or a few market sectors, reducing the opportunity to develop focused company expansion. Hence, Eatec have mainly been expanding the business on an opportunistic basis.

The range of services offered by each staff member has grown mainly as a result of the on-going projects with Eatec's key client. The Directors at Eatec identified areas of the engineering consultancy market that they were keen to enter and had employed people with the specific skills so that Eatec could develop business within that sector. These areas

included skills such as Structural Integrity Assessment and CFD. This suggests that the company has grown by being reactive to the needs of their clients or reactive to a particular market.

The Directors recognised this problem but have continued to do business this way because there was insufficient time and resource to develop strategic marketing planning. In particular, the Directors had insufficient experience in the evaluation and selection of diverse market sectors but did not want to pursue a segmentation strategy based purely on intuition. This appeared to be their main problem which hindered the process strategic marketing planning for the business.

1.4 Eatec's marketing efforts

Eatec did not have in place a formalised marketing strategy. The only promotion Eatec had adopted at the time of this study was through advertisement in 'Professional Engineering' (a journal of the Institution of Mechanical Engineers). Eatec's advertisement had been in the journal for at least two years prior to the researcher's employment. The objective of the advertisement was to raise awareness of the company and to procure work as a direct result of the advert. However, the Directors did not know the level of awareness or business leads this advertisement generated. Nevertheless, Eatec maintained its advertising column because it was their only form of known marketing method. The journal was not targeted to a particular market sector but to users of professional design engineering consultancy services. This elaborates a strong need for the Directors to develop knowledge in market segmentation so that more effective and strategic marketing campaigns can be developed.

Aside from advertising, Eatec also maintained a website. Traffic to the website was never monitored but the advertisement did show Eatec's website link so potential users may have used the website for further information.

1.5 Understanding Eatec's market sectors

To develop a picture of the market sectors that Eatec have been working in, the researcher looked at past business records from 1999 to 2001.

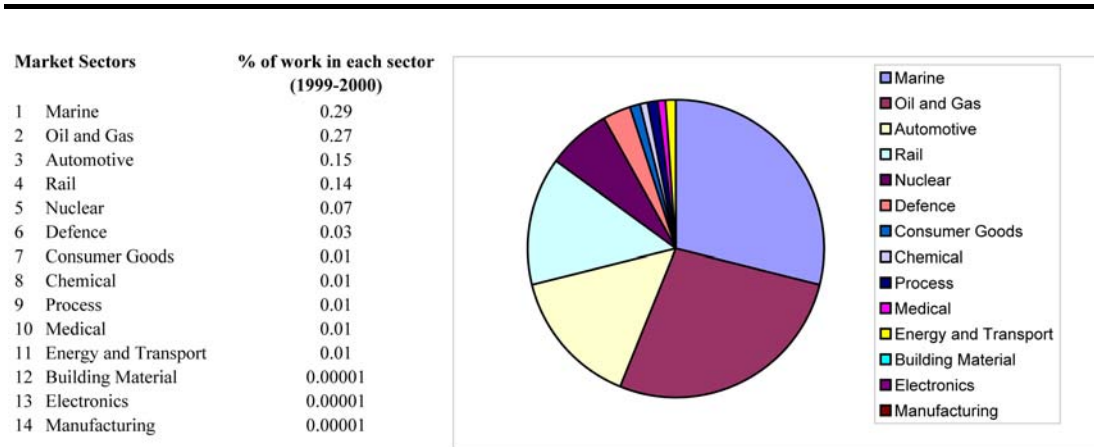


Figure 1.3. Eatec's market sectors (1999-2001)

From August 1999 to July 2000, Eatec worked in 14 different market sectors (figure 1.3). The top 4 market sectors where Eatec carried out most of their projects were marine, oil and gas, automotive and rail.

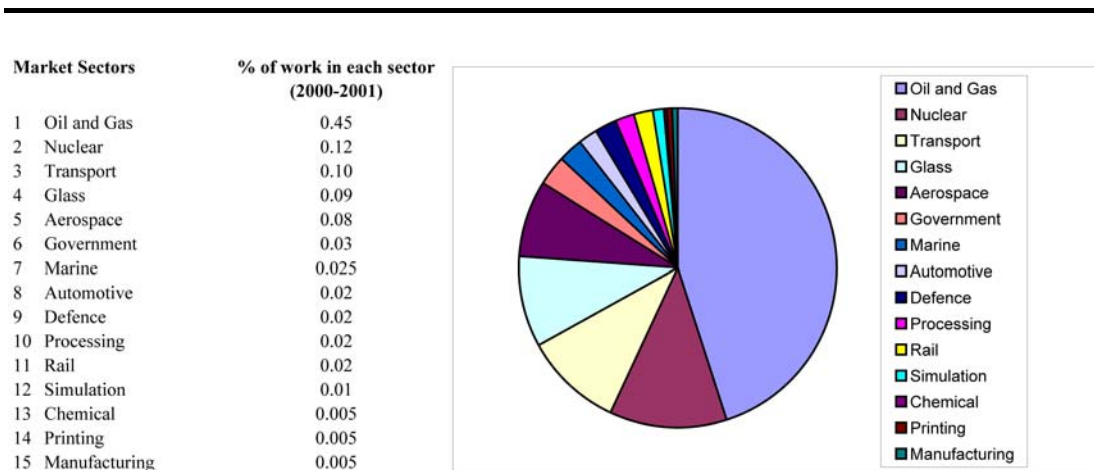


Figure 1.4. Eatec's market sectors (2000-2001)

From August 2000 to July 2001, Eatec worked in 15 different market sectors (figure 1.4). The top 4 market sectors where Eatec carried out most of their projects were oil and gas, nuclear, transport and glass.

A review of Eatec's business in the last two years preceding this research showed that the only consistent work came from the oil and gas market sector. Eatec's worked spanned over 14 to 15 market sectors and the sectors are not always the same. This posed a problem for the Directors to decide which market sectors to target. In general, Eatec's business has grown based on an opportunistic basis. These were mainly on the back of repeat business and general client demand for their services. But with increased competition, the business now needs to focus on few market sectors to plan its marketing activity. It was difficult to establish the size of the professional engineering consultancy market in the UK, given its fragmented nature. Such reports were not readily available unless purchased at corporate prices. Such research reports can be found on <http://www.marketresearch.com>. These studies included data on market size, market shares, market factors, location and funding, together with company profiles. These reports are far too detailed for the purpose of what Eatec required. Therefore, only efforts were made to identify Eatec's immediate competitors through internet search engines and through discussions with the Directors.

There are many types of engineering consultancy including environmental, civil, structural and mechanical. Within the area of mechanical engineering consultancy, there are different sizes of consultancies from very small 1 or 2 people operations to large international companies. The ranges of services are also very broad. From a general web search it would appear that many consultants positioned themselves as 'design' consultants, while others including Eatec Ltd are more involved in the analysis area of the market.

The researcher sought advice from the Directors regarding the main competitors in their field of engineering. Coupled with information which the researcher gathered through web search, a summary of Eatec's main competitors are listed in table 1.3.

Company	Main services	Markets	Turnover (2002) £	Staff
WS Atkins plc	Asset / facilities management Design Engineering Environmental services Expert services Information technology Management consultancy Planning Programme management Project and cost management Project finance Property agency	Aviation and defence Education Government Health Highways Manufacturing Nuclear Oil and gas Power Rail Telecoms Transport Water	240m	12000
Fraser-Nash Consultancy	DSTAN Helpdesk Dynamic Analysis Electro-magnetics Engineering Project Management Environmental Services Expert Witness Gas Turbine Design Integrated logistic support Mechanical System Design Reliability Engineering Safety and Risk Management Simulation Software Development Structural Design and Analysis Thermo-fluids	Civil Aerospace Defence Industrial Power Transport	5m	88
Cape Engineering UK Ltd	CFD FEA In-house Testing Software	Aerospace Automotive Defence Energy Rail Telecoms	3m	52
Wilde and Partners	Civil Design Services FEA Recruitment	Commercial Industrial	1m	not available
Engenuity Ltd	Automotive Heat Transfer Structural Analysis and Design	Industrial	not revealed	17
Best Solution Consultancy Ltd	Design Consultancy – CAD FEA LF and HF Electromagnetics Stress Analysis	Unspecified	not revealed	4
Eatec	Design assessment & optimisation Structural integrity assessment Thermal analysis Dynamic analysis Mathematical modelling Software development Neural network modelling Testing Research	Transport Defence Power Oil and Gas Marine Aerospace Industrial	not revealed	11

Data correct at time of research in 2002

Table 1.3. Competitor analysis

Eatec's main competitors also offered a variety of design engineering services. However, it seemed that only the larger organisations such as WS Atkins could afford to cover a wide base of market sectors because of sufficient resource to sustain such a strategy. The other competitors of a smaller size had chosen to target fewer market sectors, six sectors at most.

Eatec's own resource is limited. Therefore, in order that they can remain competitive, it became clear that the company **must** evaluate and select fewer market sectors to target. The research problem became prominent at this point. The lack of knowledge and experience in segmentation was the main problem that was hindering the process of developing a strategic marketing plan for the business.

This background understanding in an attempt to define the research problem posed an interesting challenge. The area of business-to-business segmentation, in particular in the context of small companies has not received a great deal of attention in the extant literature. It was possible through the knowledge transfer partnership project, in which the researcher was employed in the company, to investigate this problem through action research.

1.6 Summary to chapter 1

The introduction and background understanding has revealed that the implementation of a marketing strategy was hindered by the lack of knowledge and experience on the Directors part to evaluate and select favourable market sectors.

As a result the company had developed work in 15 market sectors. This disadvantages Eatec in comparison to its competitors of a similar size because their attempt to cover too many market sectors with limited resource has left them a 'jack of all trades'. They have been unable to develop a focused marketing strategy implementation to develop strong credibility in a few key market sectors that are valuable to Eatec's business expansion.

This background understanding has helped to deliver the research problem. That is, the Directors need to evaluate their current market sectors and select a few favourable ones to develop a more focused marketing strategy.

Business-to-business segmentation is a much talked about topic. Market segmentation is one of the steps that go into defining and targeting specific markets. It is the process of dividing up the market or industry into distinct groups that require different services. Marketing theories have suggested that businesses adopting a market segmentation approach can enhance their organisational performance (Kotler and Keller, 2005). Thus, finding a suitable segmentation strategy for Eatec by implication would enhance company growth in a more strategic rather than opportunistic manner. The following research question was established.

Research question:

How can Eatec evaluate and select their market sectors?

Action:

Develop a segmentation strategy

The following chapter reviews the extant literature covered in the area of business-to-business segmentation. Chapter 3 covers the different methodologies used to carry out this MPhil research. Chapter 4 presents the findings on Eatec's strategic marketing process and implementation. The researcher follows the Directors' decision making process to understand how methods were adapted to assist in the evaluation and selection of target markets. Chapter 5 compares the findings from this study with the literature discussed in chapter 2. Chapter 6 draws the conclusions with regards to industrial recommendations as well as contributions of the research to theory and further areas of research.

Chapter 2

Literature Review

The focus of the research is business-to-business segmentation. The process of managing a business-to-business segmentation strategy needs to be understood before an appropriate plan could be developed to assist the Directors with the decision making involved in the evaluation and selection of their market sectors.

It is important to begin the literature review by offering an evaluation of why managers need to segment markets. Next, it is essential to highlight the difficulties associated with implementing business-to-business segmentation. A detailed understanding of existing literature on business-to-business segmentation is then acquired to enable the researcher to identify the most appropriate models and theories which will underpin the primary research activity.

2.1 Why do managers segment markets?

Market segmentation is needed because it is necessary to balance diverse customer needs with the capabilities and resources of competing organisations in the marketplace. In most markets, it is unrealistic for a single organisation to satisfy all customer products and services needs all of the time (Dibb and Simkin, 1997). The whole idea of segmentation is based on the fact that differences among buyers exist (Dibb and Wensley, 2002). A company is more likely to achieve a match between their capabilities and the diversity of needs by concentrating on customer or sector groups with fairly homogenous requirements (Choffray and Lilien, 1980; Webster, 1991).

There is no doubt that segmentation leads to a better understanding of customers' needs and characteristics (Dibb and Simkin, 1997). This enables the company to develop strategic marketing programmes and gain a better insight into the competitive situation to be achieved (Bonoma and Shapiro, 1984; Powers, 1991). Efficient allocation of resources and being able to assess the relative attractiveness of potential markets sectors in alignment with the firm's objective is important (Kotler and Keller, 2005). Such segmentation analysis ensures the balance of marketing activities contributing to different market shares and profitability (Dibb and Simkin, 1997).

Segmentation is particularly useful for smaller companies who have a lower market share with limited resources because marketing efforts can be focused on developing and sustaining activity in markets that are of low risk to the company (Hammermesh et al., 1978). Dibb and Simkin (1997) also suggested that the effective use of market segmentation should help to develop and maintain an edge over rival organisations. There is no doubt that there is more than sufficient literature to support the fact that segmentation is an inevitable process to successful strategic marketing planning, but managerial guidance needs to be sought from the literature.

2.2 Difficulties in business-to-business segmentation

The idea of segmenting markets, of breaking them down into relatively homogeneous groups that are then selectively exploited, is logical and appealing. However, it was recognised that a number of problems existed in putting the theory into practice (Dibb and Simkin, 1997; Palmer and Millier, 2004; Dibb and Wensley, 2002). Among these were the issues of context, interactivity, difficulty, and implementation (Palmer and Millier, 2004) which make segmentation a challenging and difficult task in managerial practice for the following reasons.

The difficulties surrounding the *context* suggest that in specific circumstances and conditions, generalised and prescriptive guidelines may be inappropriate. By adding more criteria to reflect the complexity does not make the task in hand easier for a manager. No two companies are the same (Freytag and Clarke, 2001) and therefore this makes it difficult to develop one segmentation methodology to fit all environments. Piercy (1992) illustrates an example in the corporate banking sector where some banks divide their customer base using standard segmentation criteria of turnover and/or size. Despite the fact that these businesses talk about the resultant groupings as if they are genuine customer segments, in practice they may fail to delineate between customers in terms of product requirements and buying behaviour (Meadows and Dibb, 1998). Although many businesses see segmentation as a convenient way of carving their markets into more manageable pieces, in a marketing sense it may fail to deliver homogeneous customer segments. This means that while the organisation may find its business operationally simpler to manage, it will be unable to enjoy the benefits associated with customer-based segmentation. For example, as the corporate bank example showed, it may not be possible to develop a distinctive and appropriate marketing programme for a particular segment (Doyle, 1995).

The notion of *interactivity* recognises the fact that the application of complex, linear and step-by-step guidelines for managers may be inappropriate because suppliers and buyers are in a constantly changing environment, one in which development, learning, and feedback loops all exist (Palmer and Millier, 2004). On the other hand, the logic of segmentation, targeting, and positioning is a largely linear process, carried out at a point in time (Sollner and Rese, 2001). No sooner has a segmentation study been conducted, than it is out of date and continues to decay. In addition, the managers may have other contextually relevant and appropriate information at the time, but are unable to utilise it because it does not fit readily within the segmentation framework proposed (Palmer and Millier, 2004). One of the problems when seeking guidance from academic segmentation literature is the underlying assumption that existing segmentation schemes can be scrapped to allow the analysis to begin afresh. This is far from the practical reality (Dibb, 1998). Even assuming that the resources are available to undertake the necessary analysis, the planning and execution of segmentation exercises are constrained by a number of practical and operational concerns (Young et al., 1978).

While segmentation has been identified as a key strategic element of the marketing activity, the process is both *demanding and difficult*. The process demands both time and attention, but managers are often diverted by urgent, more important and short-term issues (Mintzberg, 1973). As a result, segmentation work gets pushed aside and avoided due to lack of understanding practical knowledge on how to approach the task. To add to the problem of difficulty, there are discrepancies in priorities between existing literature from academic researchers and practitioners. Academic researchers emphasise the need for segmentation techniques to be statistically robust, and from practitioners who focus on segment for which clear marketing programmes can be developed. Saunders (1987) and McDonald and Dunbar (1995) suggest that academic publications underestimate the problems of 'real world' applications. There is a lack of practical advice and little emphasise is placed on implementation issues (Hooley, 1980). Others such as Dibb (1998) have shown that practitioners simply avoid these difficulties by using intuition rather than systematic analysis to identify segments (Wind and Cardozo, 1974). Dibb (1998) indicated that a manager needs guidance in drawing up the variables or criteria to use to segment the market, such as size or competitiveness. However, once a manager has segmented the market sectors using the set criteria, the manager potentially faces an x number of market sectors which are of equal attractiveness. At this point, a manager may wish to use a formalised method to select a few target markets only rather than cherry picking selective markets based purely on intuition and personal experience.

Intuition or better known as 'gut feel' is the combination of experiences, knowledge and past performance of managers, which contributes to strategic decision making. Courtney et al. (1997) cautions the use of novel methods of planning or intuition based strategy and suggests taking on a more measured approach. However, there are also others who suggest that intuition (Mowen and Gaeth, 1992) and good judgement (Brownlie and Spender, 1995) are required because rigid planning systems in dynamic industries where there is little experience on which to base future activity are no longer relevant. Many people fail to realise that an intuitive synthesis is actually a sub-conscious derivative of the accumulation of years of management experience (Khatri and Ng, 2000). Although it is a risk to rely solely on experiential knowledge because environments change and are difficult to predict (Walker, 1985), it is the ability to amalgamate 'gut-feel' with marketing intelligence within a selection and evaluation process that makes an intuitive contribution valuable. Bonaneau (2003) contends that the scale of change and unpredictability in certain markets makes intuition irrelevant because intuition is formed over time by historical experience. Incidentally, such markets move at such a pace that long term planning does not necessarily add any value. Therefore, Bonaneau (2003) proposed an amalgamated view to include a mixture of hands on management of a responsive strategic planning process, using intuition as an input to the process and not as the solution.

A manager can decide whether or not to include intuition as a contribution factor to evaluation and decision-making, but fact of the matter is that the difficulty in implementing business-to-business segmentation remains. A formalised method to evaluate and select market sectors needs to be established.

Dibb (1998) compares and contrasts the segmentation priorities between academics and practitioners (table 2.1). It is clear that practitioners demand a much more realistic and doable approach to segmentation and one that the managers can apply into their existing business strategies. Although the academic literature focuses extensively on the use of different statistical approaches in segmentation research which makes for a more robust segmentation scheme, there is very little practical guidance about the numerous problems and pitfalls (Dibb, 1998). The danger is for managers with limited statistical training that these pitfalls can have serious consequences.

Academic (research)	Practitioner
"Correlational" research: begin with actual behaviour, then search for variables to explain it	Interested primarily in why customers behave as they do
Main emphasis is on techniques for doing the analysis	Look for relationships between wants and goals, attitudes and subsequent behaviour
Tendency for quantitative presentation, using approach such as multiple regression, conjoint analysis, etc.	Tendency for qualitative presentation, may use cluster analysis or possibly no multivariate statistics
Widespread efforts to increase/refine the use of different techniques	Recognise the constraints of existing company structure, so focus on implementation concerns
	Interested in how segmentation output can be used in planning

Table 2.1. Comparing and contrasting academic and practitioner priorities in segmentation research (Dibb, 1998)

Even if managers undertake and achieve an appropriate segmentation process, they still have to rely on colleagues in other departments to *implement* the actions arising (Palmer and Millier, 2004). Barriers to effective implementation include the fact that managers are often given insufficient guidance on making segmentation work, or how to evaluate the corporate attractiveness of different segments.

Insufficient guidance is not the only reason why segmentation fails. A misunderstanding of segmentation by some managers is also a common fault. Some businesses make mistakes by viewing segmentation as a tactical trick rather than as a strategic marketing tool (Dibb, 1998). Like any marketing planning activity, segmentation analysis needs to have a longer time horizon. Segmentation should begin with a clear analysis of customer needs and buyer behaviour. The manager must also examine the competitive and wider trading environments in order to create consistent marketing programmes which should be implemented over time. As Dibb (1998) illustrated, segmentation has become the panacea for anything and everything. When the month's figures are poor, the managers would visit the promotions office with a steady stream of requests for quick-fix campaigns. Segmentation is sometimes viewed in the same manner, when used tactically it can deliver short-term benefits but ignores the need for a longer-term perspective. For the client the result can be a confusing mix of inconsistent marketing programmes (Dibb, 1998).

It appears vital that a segmentation 'process' is devised for a longer-term perspective rather than a 'quick-fix' of problems. It should also align with the business' on-going strategy and that it takes into consideration the current situation and operational constraints which the business faces. As Dibb (1998) highlighted, the output must be sensible, robust, but also meaningful in terms of these constraints. If these factors are ignored, it may be impossible or impractical to implement the resultant segments.

In the next section, various segmentation models are examined. Due to the nature of Eatec's fast moving market environment in engineering, the role of intuition (Walker, 1985; Mowen and Gaeth, 1992; Brownlie and Spender, 1995; Courtney et al., 1997; Khatr and Ng, 2000; Bonaneau, 2003) is considered in the decision making process, along with formalised methods of segmentation.

2.3 Business-to-business segmentation: models and theories

2.3.1 Macro-micro segmentation models

In comparison to consumer market segmentation, business-to-business segmentation has been under researched for some time (Bonoma and Shapiro, 1984; Plank, 1985). The use of segmentation techniques in business-to-business markets is largely based on traditional variables such as size and Standard Industrial Classification (SIC) codes (Crittenden et al, 2002). Using SIC codes is a convenient way of undertaking business-to-business segmentation but it has been criticised for being too simplistic, biased towards manufacturing rather than services, misleading, too highly aggregated, often out of date, and not necessarily sufficiently related to the need of the user (Mitchell and Wilson, 1998).

Variables like company size and SIC codes are referred to as macro variables by Wind and Cardozo, (1974) and that such variable can be further divided into micro-segments based on additional measures that relate to purchasing behaviour. This is demonstrated in table 2.2.

Macro variables									Macro segmentation
Company size			SIC codes			Other			
micro variables	micro variables	micro variables	micro variables	micro variables	micro variables	micro variables	micro variables	micro variables	Micro segmentation

Table 2.2. Micro-variables within macro-variables, illustrating Wind and Cardozo's (1974) theory

The macro-micro two stage processes are focused on easily determined characteristics of the customer such as Standard Industrial Classification (SIC) category, organisation size and structure, and geographical location in the former stage and the latter stage, micro-segmentation focuses on decision-making units within each macro segment. Wind and Cardozo (1974) created a flow diagram (figure 2.1) which demonstrated the two-stage

approach to industrial marketing segmentation. The approach uses organisational characteristics to develop macro segments and then identifies micro segments on the basis of decision-making unit (DMU) characteristics. The principle of Wind and Cardozo's (1974) approach was that current sectors could then be further sub divided to form more homogeneous sub-segments.

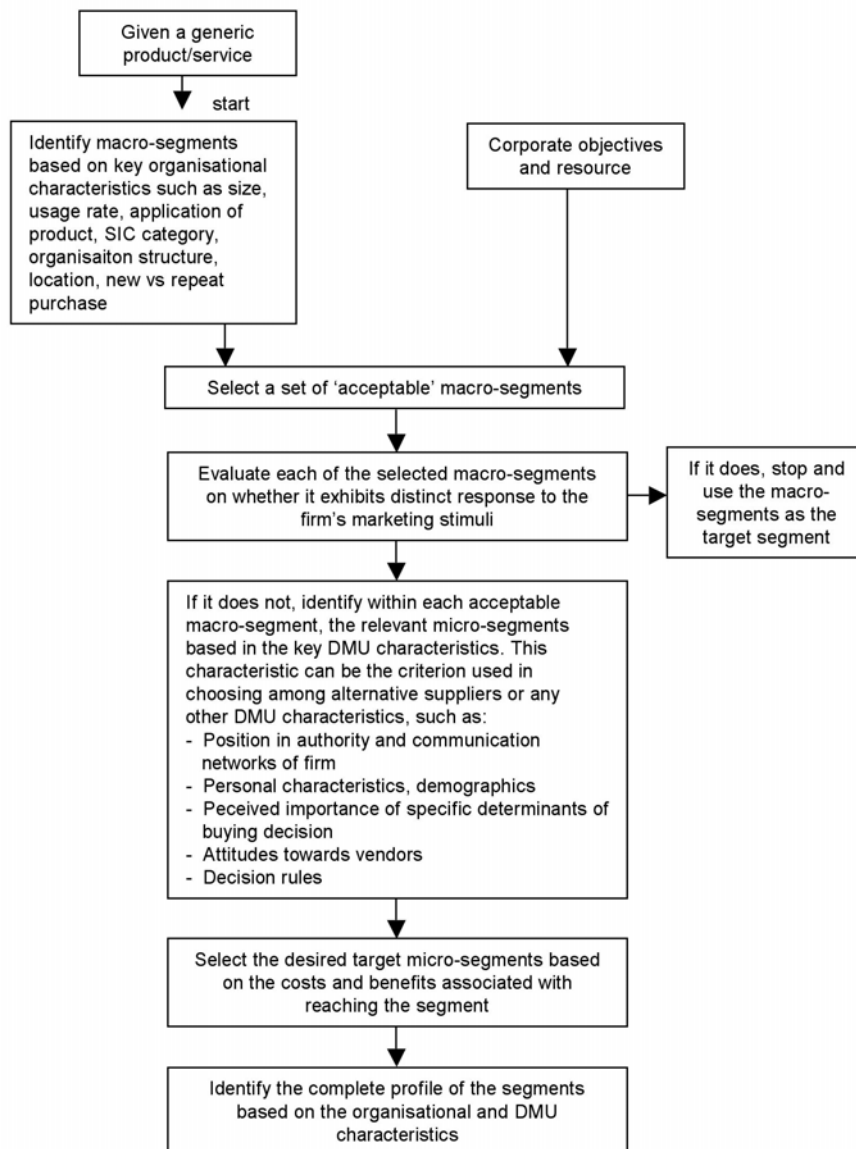


Figure 2.1. Macro-micro model of industrial market segmentation (Wind and Cardozo, 1974)

This micro-segmentation stage was subsequently developed by Bonoma and Shapiro (1984). Their model splits into five layers (figure 2.2). The outer layer is where the decision maker would begin the segmentation process with easily identifiable macro variables such as demographics. The decision maker would continue to carry out its market segmentation until

a “good enough” schema is found for the business. However, each successive layer increases in complexity and cost.

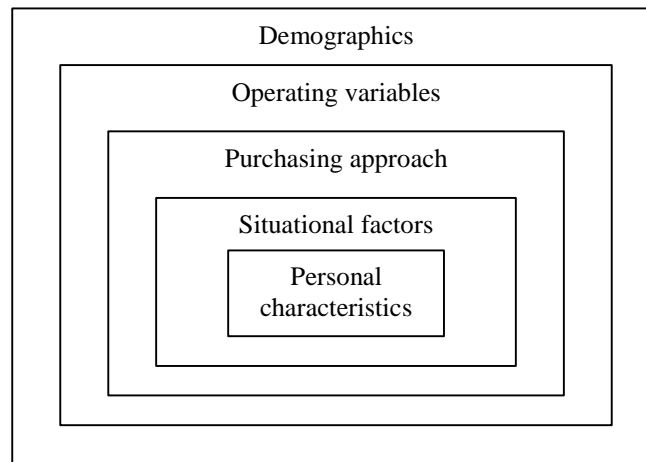


Figure 2.2. Five-layered nested model (Bonoma and Shapiro, 1984)

Bonoma and Shapiro (1984) highlighted that a segmentation process using the characteristics of the outer layer is most easily ‘identifiable and accessible’. In such an approach, target segments are identified based upon readily available secondary data (e.g. SIC codes). Accessibility is determined by the technological capabilities of the supplier rather than by the needs of the buyer. Companies are encouraged to commence with readily implementable variables, such as demographics, and proceed inwards to situational factors and personal characteristics only if required (Dibb and Simkin, 1997).

However, to develop a strategy based on the specific ‘needs and benefits’ to the customer rather than what the vendor wants to sell would require a segmentation approach that adopted characteristics which are customer driven. These variables might include the customer’s technology base, use or non-use of particular products or services, the nature of existing organisational relationships or purchasing policies and buyer motivation (Bonoma and Shapiro, 1983). This approach would give the vendor competitive edge but is extremely costly and complex to manage. Collecting such measurements of micro-segmentation characteristics is difficult, costly and time consuming because these are bespoke data and could be viewed by the customers as an invasion of privacy (Robertson and Barich, 1992; Dibb and Simkin, 1994). Adding to the fact that it is difficult to prove that business success is linked with effective segmentation (Esslemont, 1996), a company would find it hard to justify investing vast amounts of time and resource into such complex need-based segmentation.

Dibb, Stern and Wensley's (2002) research indicated that although their respondents were not convinced that segmentation can improve business performance, it was believed that carrying out segmentation does improve customer understanding. But if an organisation has successfully adopted a segmentation strategy at the micro-level, then it is inevitable that over time it has developed a sophisticated client profile. The organisation would have improved and adjusted their segmentation techniques along each milestone to gain a better understanding of the customer (Hague, 2002).

Hague (2002) agreed with Wind and Cardozo (1974) and Bonoma and Shapiro (1984), that a company with no initial background on segmentation should begin using convenient and easily obtainable macro variables such as geography and size of company to segment its market sectors. Once better customer understanding is gained, the company can move forward to the next phase of segmentation by looking at micro variables of customers on buying behaviour and then further into customers needs. This process is illustrated in figure 2.3. Segmentation at the early stages is easy to imitate by competitors because the variables are easily obtainable. Hence, if a similar sized competitor also segmented the market using geography, then potentially both companies would end up with similar client bases. Whereas if one company segments its market based on a sector's particular buying behaviour or particular needs, then there is less chance that two companies would end up with similar client bases. That segmentation process would also run in parallel with the company's objectives and resource and as such each company is different. Hague (2002) implied that segmentation is a journey, an ongoing process. This would support Dibb's (1998) view that the true benefits of segmentation is that it is not a 'quick-fix' of problems but must be viewed as a 'process' devised for the longer-term perspective.

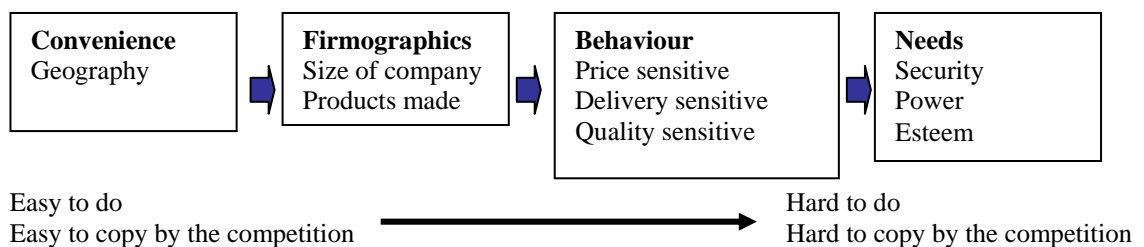


Figure 2.3. The road to a needs-based segmentation (Hague, 2002)

2.3.1.1 Summary to section 2.3.1

The macro-micro segmentation approach and models described are potentially relevant to Eatec's context. The macro segmentation stage uses characteristics such as company size and geographic location which could assist the Directors to select a set of acceptable target clients. Following this stage, the Directors could potentially adopt the second stage to narrow down the segment by identifying authoritative decision makers to find the desired target client. In parallel to this macro-micro two stage process, the directors would maintain focus on the key corporate objectives (which would need to be defined) and the resource it has in-house to provide for the selected target clients.

However, the company currently works in at least 15 diverse market sectors, each with very different types of client. The macro-micro segmentation approach described above is potentially useful when Eatec has selected fewer target markets. But until then, the priority for Eatec is to find a method to evaluate and select between equally favourable market sectors. Hence, a more structured approach needs to be explored. This is discussed in the next section.

2.3.2 Structured approaches to the segmentation process

Knowledge gained through marketing intelligence is an essential input into the segmentation process but structured approaches needs to be in place to enable the analysis to be fed back into strategic thinking and marketing plans (Dibb and Simkin, 1997; Brooksbank, 1999; Freytag and Clarke, 2001). To isolate one from the other emphasises a weakness in communications, skills and integration of business decisions (McDonald, 1989).

Goller et al. (2002) highlighted that business segmentation has received considerable attention in academic literature but each research area has largely been investigated in isolation from one another. In their opinion, these shortcomings have resulted in a view of segmentation which failed to recognise the long-term strategic nature of the concept.

An ongoing relationship with customers, where customers look for value in the total service offering, requires internal collaboration among functions and departments. The whole chain of activities has to be co-ordinated and managed as one total process (Grönroos, 1996). If segmentation is structured poorly, the post development of strategies and marketing programmes could lead to implementation problems (Bonoma, 1985).

To ensure a structured approach to segmentation, Dibb and Simkin (1997) developed a step-by-step guide for managers, taking them through from segmentation to implementation. They acknowledged the difficulties managers faced when implementing segmentation schemes that were too academically orientated. Hence, the aim of this model was to overcome some of the implementation barriers highlighted by Bonoma (1985) and emphasised on practical implementation issues (Hooley, 1980). Dibb and Simkin's model highlighted three stages: the 'now' as the core analyses, the 'future' as strategic thinking, and the 'how' as implementation programs (figure 2.4). Their study highlighted four points:

- 1) Effective segmentation requires management commitment and an appreciation that marketing is not just the domain of functional specialists but involves a company-wide commitment. This research had the commitment of all three Directors at Eatec because they understood the need to adopt a segmentation strategy based on their diverse client base. Incidentally, the results of the segmentation strategy can then be integrated into their strategic marketing planning (Goller et al., 2002).
- 2) The process should not be long-winded but must allow for the capabilities of the firm at the various program stages. Dibb and Simkin (1997) showed that some of the firms who used the program had taken a long time to gather relevant information, whilst others needed a longer period to formulate marketing plans. The process in Eatec's context is based on a two-year knowledge transfer partnership, in which the company employed the researcher to facilitate the segmentation process. It was envisaged that the first year would be to develop an appropriate marketing strategy. The segmentation process would be integrated within this first year. The second year was to develop and implement appropriate marketing strategies.
- 3) A facilitator is required (Richardson, 1995; Dibb and Simkin, 1997) – ideally an outside consultant – to insure that the process holds together. In addition this person can challenge the prevailing marketing ideology at a firm if it contradicts the strategy. As highlighted above, the research is the 'outside facilitator' in this context.
- 4) Any segmentation strategy must encompass performance measures and benchmarking. Without these elements any appraisal of the implementation becomes once again a matter of guesswork and simplistic analysis. The researcher acknowledges this point highlighted by Dibb and Simkin (1997). However, the researcher is only employed in Eatec for two-years. Due to limited time and

resource, the researcher will not be able to fully investigate performance measures of the developed segmentation strategy. However, the focus of this research is to understand the evaluation and selection process of market segmentation. Therefore, the researcher will aim to discuss on successes and failures of that process. Thus, recommendations can be made for amendments to the segmentation strategy for future use.

Figure 2.4 starts with an examination of existing markets and market share situations (stage A: core analyses) that affect the buyer behaviour and the customers' needs. This stage is important as it determines the segment bases and ultimately identifies the central segments in a market. When defining a marketing strategy, quite often managers rely on intuition rather than hard evidence. There is also a tendency to reject information conflicting with a particular view of the marketplace (Dibb and Simkin, 1997). Therefore, the core analyses stage is carried out to help managers understand the current company situation and a segmentation strategy can then be developed accordingly.

Stage B of the model provides guidance to managers in thinking strategically about their business in the future. This stage highlights the business-to-business segmentation process and contends with the purpose of this research in Eatec's context, to evaluate and select target market sectors. They proposed that at this stage a manager would need to:

- 1) identify segmentation criteria
- 2) determine revised market segments
- 3) select new/revised segments
- 4) determine positioning strategies

Whilst these are valid points in which the researcher would consider to develop an appropriate segmentation strategy for Eatec, it does not offer implementation guidance on how to select between equally favourable market sectors. This is where a manager, when faced with the problem of having to choose between equally favourable market sectors, is likely to rely on intuition in order to rate one sector over another. But it is for precisely this reason that the directors at Eatec are seeking a more formalised and structured approach, which allows a decision maker to incorporate intuition as well as gathered marketing intelligence when evaluating and selecting between market sectors.

A: Core analyses (Now)

- The existing situation
- General trends/marketing environment
- Strengths, weaknesses, opportunities, threats
- Customer needs/expectations/buyer behaviour
- Competitive positions/strategies
- Brand or product positionings
- Balance of portfolio

B: Strategic thinking (The future)

- Identification of new segmentation criteria/segmentation bases
- Determination of new/revised market segments
- Selection of new/revised target segments
- Determination of brand positioning strategies

C: Implementation programs (How)

- Marketing programs
 - o Product range and portfolio
 - o Pricing and payment issues
 - o Promotional strategies and tactics
 - o Distribution and control
 - o Service levels and personnel
 - o Sale force
 - o Internal communications and organisations
 - Resources and scheduling
 - o Budgets
 - o People and responsibilities
 - o Activities
 - Ongoing requirements
 - o Product/brand development
 - o Marketing research
 - o Training
 - o Communications
 - o Monitoring performance
-

Figure 2.4. The stages of segmentation (Dibb and Simkin, 1997)

Freytag and Clarke (2001) proposed that in order to select the best segments, thorough studies of different market segments need to be conducted and then to select those that create competitive advantage for the company. A segment that is large, growing, and has little competition may not be the right choice for a company when it is unable to achieve its desired position in the market because of internal financial, managerial or capability restraints. Freytag and Clarke (2001) devised a multi-step process to help managers find a match between segment demands and optimal use of their company's skills and capabilities (figure 2.5).

The process begins with an on-going review of segment identification and evaluation, similar to that of Dibb and Simkin's (1997) model. However, the limitations are that it focuses only on segmentation. It does not illustrate how the strategy is integrated into wider marketing initiatives within the company, which was deemed important as highlighted by Dibb and Simkin (1997). Moreover, like Dibb and Simkin's model (1997), Freytag and Clarke's model (2001) also failed to offer implementation guidance on how to select between equally favourable market sectors. Incidentally, the final step of Freytag and Clarke's model ends with '*the target segment(s) can now be selected*' which is the research question we have come to face.

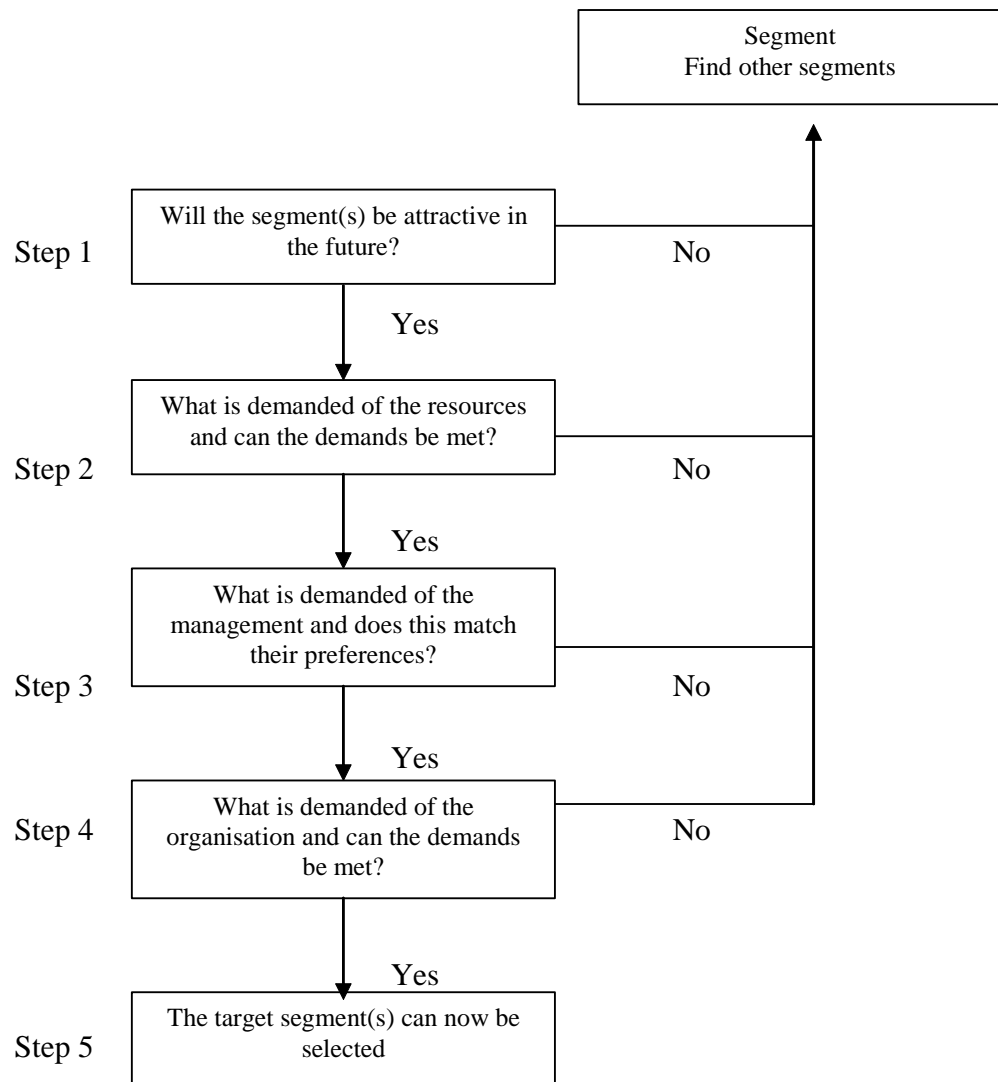


Figure 2.5. A Segmentation Selection Process (Freytag and Clarke, 2001)

Goller et al. (2002) believed in a structured and integrated segmentation process. Incidentally, an integrated framework of business-to-business segmentation model was introduced. The framework (figure 2.6) consists of four main sets of components:

- 1) An antecedent to segmentation which can influence the entire segmentation process
- 2) The prerequisites of the segmentation process
- 3) The segmentation process
- 4) An outcome of the segmentation process

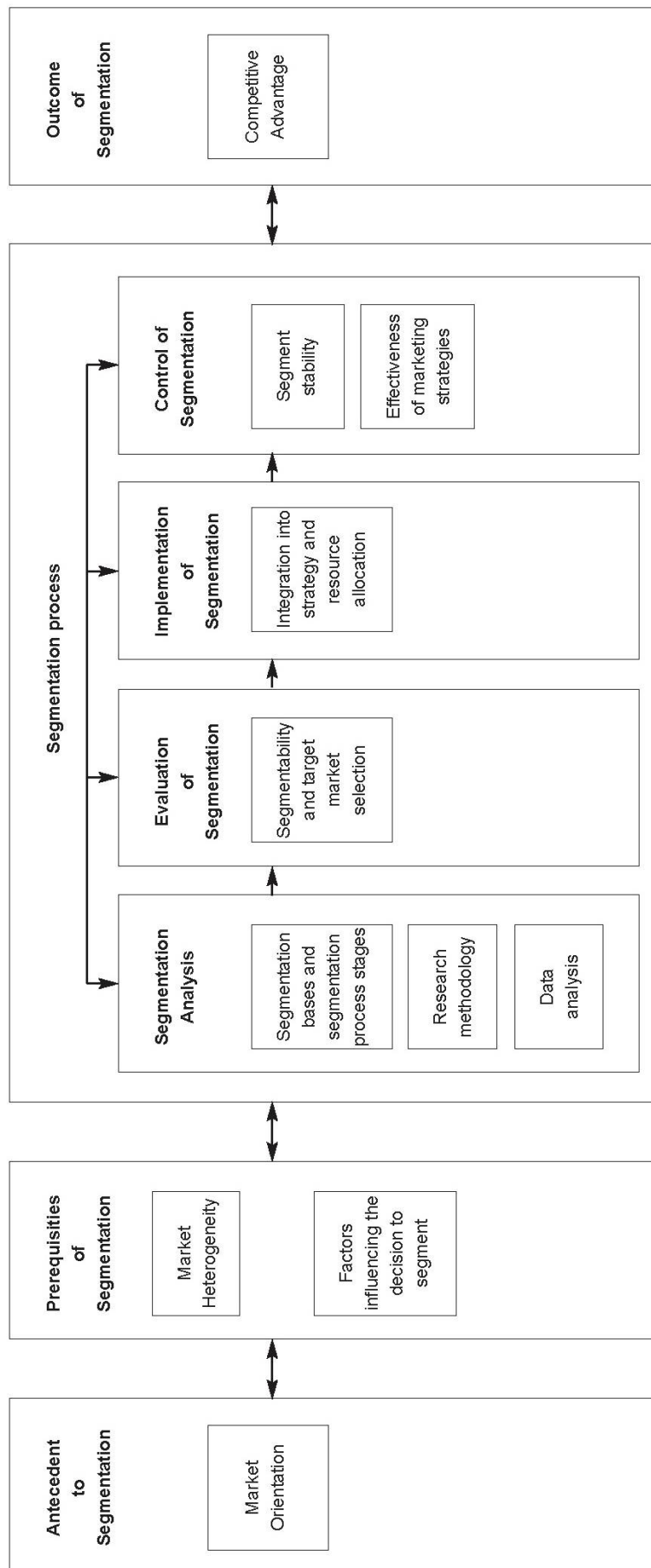


Figure 2.6. An integrating framework of business segmentation (Goller et al., 2002)

The first two components preceding the actual segmentation process looks at market orientation and factors which influence the decision to segment. For a business to achieve superior performance, it has to sustain competitive advantage. Where competitive advantage was once based on structural characteristics such as market power, economies of scale, or a wide range of services and product lines, the emphasis today has shifted to capabilities that enable a business to consistently deliver superior value to its customers (Slater and Narver, 1994). Specifically, this entails the business to collect and coordinate information on clients, competitors and other significant market influencers. Whilst this would assist in developing a better understanding of the client profile to deliver a better service or value to its customers, it does not influence the segmentation process.

One of the factors for businesses to carry out segmentation is due to the diverse number of end uses for a product or service that the client could potentially belong to an equally diverse number of industries (Plank, 1985). Consequently, the application of a product or service could potentially vary considerably for clients within an industry. This means different clients within an industry could seek different benefits from the same service (Powers, 1991). Incidentally, Eatec has provided for a diverse number of market sectors that it has become difficult to define specific benefits or unique selling points to an industry. Hence, a more strategic approach is required by means of adopting a business-to-business segmentation strategy so that the company can develop a more focused marketing strategy in future.

The actual segmentation process illustrated by Goller et al. (2002) consists of four phases:

- Segmentation analysis;
- Evaluation of segmentation;
- Implementation of segmentation; and
- Control of segmentation.

Segmentation analysis looks at dividing a heterogonous market into homogeneous sub-markets. That is to define an appropriate segmentation base to use. Goller et al. (2002) categorised segmentation bases into two groups, macro variables and micro variables, which was discussed in a previous section. The choice of segmentation base has implications for other elements of the segmentation analysis phase such as the type of data to be collected and the method in which to collect it. For example, macro-segmentation bases make limited methodological demands where secondary data source or expert judgement is sufficient and thus more appealing to the practitioner. Micro-segmentation bases on the other hand are

methodologically more demanding and require the collection of primary data, but the data would be purposeful and specific to the segmentation context.

Goller et al. (2002) highlighted that in defining the appropriate segmentation scheme, it also needs to be actionable, measurable, substantial and accessible. There is little point in deciding on a scheme if the company does not have the capacity to carry it out. The evaluation of segmentation phase includes the process of evaluating and selecting market sectors. Goller et al. (2002) indicated the use of segment size and growth, market shares, compatibility with company objectives and resources. These are criteria which can assist a decision maker in evaluating the suitability of that market sector to achieve company objectives, but it does not help with the selection process when a number of diverse markets are involved. As part of the segmentation process, the model illustrates how, after the evaluation and selection phase as explained above, that the analysis should be integrated into wider marketing initiatives. The outcome of the segmentation process would aid decision makers in developing an appropriate marketing strategy and corporate decision making as well as managing sufficient resource allocation.

The effectiveness of the segmentation process is then monitored through measures such as profitability (Bonoma and Shapiro, 1984), as well feeding the changes in consumer perceptions, behaviour or competitors' actions, back into developing future strategies (Dibb and Simkin, 1997). As discussed earlier, it is unfortunate that due to the limited time that the researcher is based at the company, a full analysis on the effectiveness of the segmentation process would not be possible. Albeit the focus of the research is to investigate the evaluation and selection process of market sectors, but it would be a recommended follow up study.

Goller et al. (2002) agreed with Dibb and Simkin (1997) that any segmentation strategy must encompass performance measures and benchmarking. The final component of the segmentation framework highlighted by Goller et al. (2002) emphasise the need to measure the outcome and competitive advantage. They argue that the outcome of a segmentation process is not just restricted to operational matters of strategy but a facilitator in the achievement of competitive advantage. It is the researcher's intent to develop a segmentation strategy for Eatec so that in the long run, operational matters of strategy can be managed effectively. However, the researcher has already explained that an analysis on Eatec's competitive advantage following the segmentation process would be limited due to time constraints. The researcher recognised the similarity in the process of both structured and integrated segmentation models (Dibb and Simkin, 1997; Palmer and Millier, 2004).

However, both fail to offer practical implementation guidance on how to select between equally favourable market sectors. They state the need to do it, but they do not state how to do it.

2.3.2.1 Summary to section 2.3.2

The structured approaches to segmentation discussed in this section (Dibb and Simkin, 1997; Freytag and Clarke, 2001; Goller et al., 2002) are useful managerial step-by-step guides, which can be adopted in the development of Eatec's segmentation strategy.

In particular, Dibb and Simkin (1997) and Goller et al. (2002) both offer extremely comprehensive guides and highlight particularly the importance of integrating segmentation within strategic marketing planning. Rather than choosing one segmentation method over another, the researcher feels that both of these models offer potential guidance in development of an appropriate segmentation strategy for Eatec's context.

The researcher agrees with three of Dibb and Simkin's (1997) findings that managing segmentation requires the commitment of the Directors at Eatec; that the process needs to be well managed and not long winded and that the presence of a facilitator is crucial. The researcher will ensure that all of these conditions are met in the management of Eatec's segmentation process.

The researcher also feels that three of the components within the integrated segmentation process (Goller et al., 2002), antecedent to segmentation, prerequisites of segmentation and segmentation process, are particularly useful and can be adopted within Eatec's context. As such, the researcher will consider elements from both of these segmentation models (Dibb and Simkin, 1997; Goller et al., 2002) in driving the research enquiry. As well as adopting structured and formalised segmentation methods, the researcher has yet to discover 'how' market sectors can be evaluated and selected in a structured and formalised way.

Emerging methods that include the use of managerial intuition has been recognised as an important factor for the basis of segmentation. Millier (2000) suggested that incorporating intuition is an excellent way to synthesise the vast range of data relevant to segmentation that managers collect through experience. In the next section, the researcher investigates the role of intuition and how it might be integrated with a structured and formalised segmentation approach.

2.3.3 Managerial intuition approach to segmentation

The difficulties faced by managers in business-to-business implementation were discussed in section 2.2. As such, segmentation difficulties are generally avoided by using intuition rather than systematic analysis to identify target segments (Wind and Cardozo, 1974). In particular, complex segmentation approaches are costly (Bonoma and Shapiro, 1984) and so small businesses generally follow a less complicated procedure, acting in highly rational and objective ways (Jocumsen, 2004) which are to:

- maintain the use of simple analytical tools
- apply extensive use of gut feel and intuition
- rely upon past decision experiences
- rely on internal advice from business associates

Millier (2000) proposed the use of managerial intuition as a valid component of a segmentation process. This was essentially with respect to emerging markets for new technological innovations, as a way of rationalising markets that were yet to be established.

The above are all valuable points (Millier, 2000; Jocumsen, 2004) and particularly relevant to Eatec's situation. The researcher does not rule out the benefits of incorporating intuition into segmentation decision making (Mowen and Gaeth, 1992; Brownlie and Spender, 1995; Khatri and Ng, 2000), but does contend with the views of Courtney et al. (1997) and Bonaneau (2003) that an intuitive based segmentation approach should be integrated into a more structured approach.

Lockett and Naudé (1996) compared the use of intuitive ranking with a method known as judgemental modelling. They investigated the role of Judgemental Modelling and how it played a large part in assisting a large manufacturer in the evaluation and selection of two strategic plans. The study showed the benefits of including a wider range of decision criteria than purely financial ones, and indicated that the approach had enhanced the group decision making process.

The traditional approach to investment decisions within the company was based on 'hard' data such as financial performance. However, it was suggested that using a multi-criteria decision making (MCDM) approach helps the decision-maker to tackle complex problems. Initially, decision makers need to agree on a set of criteria and then rate the importance of each criterion. The decision makers then need to evaluate the various business alternatives. To assist decision makers in choosing between various alternatives (Saaty, 1980; Islei and

Lockett, 1988) a decision tool (judgemental analysis software) was developed (Lockett and Islei, 1989). This is a generic decision modelling approach, based upon three stages: deciding the criteria upon which a decision is to be based, allocating weights to the different criteria, and then scoring each business alternative on the criteria.

This structured segmentation approach using MCDM within JAS enables the integration of intuition and personal experience, as well as knowledge gained from marketing intelligence into the decision making process. The approach would incorporate analysis at various levels, including weighting of the criteria. This method has been adopted successfully in a number of different business-to-business contexts (e.g. Islei et al, 1991, 1999; Lockett and Naudé, 1996; Naudé et al, 1997).

The evaluation and selection process took over three months. In order to draw a comparison between JAS rankings and intuitive assumptions, Lockett and Naudé (1996) obtained intuitive rankings from decision makers prior to using the JAS package. They did find some discrepancies between the comparisons and agreed that intuition as the only basis for decision making was disadvantaged by the heavy role that particular aspects would form the judgment (Courtney et al., 1997; Bonaneau, 2003). The validity of the JAS results were questioned, but on further investigation it was found that the outcome provided by JAS was indeed more robust than the outcome the decision makers had expected according to their 'gut-feel'.

Palmer and Millier (2004) further investigated the idea of utilising managerial intuition and personal experience within a segmentation task (Mowen and Gaeth, 1992; Brownlie and Spender, 1995; Khatri and Ng, 2000), but also facilitated the process by implementing the use of MCDM and rankings (Lockett and Naudé, 1996) in an adapted method. By working within an organisation, they were able to clarify more specifically the generic issues of segmentation when set within a business context. Criteria relevant to the firm were defined and a series of scales (low, medium and high) were agreed (table 2.3).

Segmentation criteria, definitions, and scales		
Criteria	Definition	Scale
Relative spend	A measure of the total amount spent on flavours and the proportion of that spend captured by Belmay	Revenue captured as a proportion of total spend expressed as low or high
Service requirements	The requirement for product support services seen as order fulfilment, development support, and advice on legislation	low / medium / high
Buying style and processes	The degree of formality and structure of the buying process	low / high / high centralised formality of buying process
Commercial approach	Traditional (so transactional) all relational attitude to business and supply chain	relational or transactional
Technical support	The level of technical support required	low / medium / high
Future orientation	Attitude and commitment to industry leading innovation and business growth as defined by R&D, capital investment and new customer gain	low / medium / high

Table 2.3. Segmentation criteria, definitions and scales (Palmer and Millier, 2004)

Based on the notion of action learning (Weinstein, 1995), Palmer and Millier (2004) developed appropriate segmentation evaluation tools to suit the context of the business. They also illustrated how facilitators are important in assisting with the segmentation process (Dibb and Simkin, 1997) and moderated the results in order to arrive at an agreed series of unbiased scores. The scoring of the customer base by the management team against the defined criteria is highlighted in table 2.3.

Whilst Palmer and Millier's (2004) method mirrors the JAS approach (Lockett and Naudé, 1996) of utilising MCDM and rankings as well as integrating intuition, experience and marketing intelligence within the evaluation process, it requires limited software training. Palmer and Millier (2004) developed a simpler method of capturing the evaluation data which makes it easier for small businesses to adapt a segmentation method suited to their own needs (Jocumsen, 2004). Figure 2.7 highlights Palmer and Millier's (2004) approach to data capturing of the scoring process.

CRITERIA	SCALE	CUSTOMER				
		A	B	C	D	E
Relative Spend	Low S/Low C		X		X	
S/Low C	Low S/HighC		X (med)		X (med)	High
	High S/HighC	X				
Service Requirement	L		X			
	M	X				
	H			XX	X	X
Commercial Approach	R				X	X
	T	X	X	X		
Buying Process	Low Formal	X	X		X	
Hi Formal	Hi CoreList		X			X
Technical Support	L					
	M	X	X		X	X
	H			X		
Future Orientation	L		X		X	
	M	X		X		
	H					X

Figure 2.7. Segmentation data capture (Palmer and Millier, 2004)

This matrix form of capturing segmentation data is an ideal method for Eatec's context to assist in the decision making process of evaluating and selecting market sectors. As there are three decision makers, the individual results can be summed in order to come to an agreed combined evaluation score.

2.3.3.1 Summary to section 2.3.3

The use of managerial intuition is a valid component of a segmentation process (Mowen and Gaeth, 1992; Brownlie and Spender, 1995; Khatri and Ng, 2000; Millier, 2000) but this should be used in conjunction with a good deal of structured information and analysis (Courtney et al., 1997; Bonaneau, 2003).

Lockett and Naudé (1996) offered a structured and integrated approach to decision making when evaluating and selecting between different business alternatives. The process of deciding the criteria upon which a decision is to be based, allocating weights to the different criteria, and then scoring each business alternative on the criteria is a structured decision-making approach that enables the user to also encompass factors such as experience and marketing intelligence into the evaluation. The added advantage is that a number of decision makers can participate with the flexibility to evaluate individually but with a system robust enough to combine all scores into an integrated agreement. This approach is clearly a practical solution to Eatec's context and integral to the development of a suitable segmentation strategy.

Palmer and Millier (2004) agreed with the views of Lockett and Naudé (1996) but they also illustrated the development of an appropriate method in the context of action learning. With the presence of an external facilitator, the process of segmentation was better held together (Palmer and Millier, 2004; Dibb and Simkin, 1997). Although the Directors at Eatec have best intentions to commit to developing a segmentation strategy, they are often diverted to deal with more immediate business issues (Mintzberg, 1973). As such, the researcher as the role of a facilitator will coordinate the segmentation process in an action-learning manner.

2.4 Conclusion

At the beginning of the literature review, the researcher wanted to develop an understanding of the process of managing a business-to-business segmentation strategy. From chapter 1, the researcher had established the following research question specific to Eatec's context:

How can Eatec evaluate and select their market sectors?

The literature review has proved to serve the root of why this needs to be done. Segmentation leads to a better understanding of customers' needs and characteristics. Based on the diverse market sectors which Eatec are involved in, it is unrealistic for them to satisfy all market needs (Dibb and Simkin, 1997). Particularly for small companies with lower market share and limited resources, segmentation is advantageous because evaluating and selecting the most favourable market sectors would enable them to focus on developing and sustaining activity in markets that are of low risk to the company (Hammermesh et al., 1978).

However, segmentation does not come without difficulties. Long standing key issues include time and resource (Mintzberg, 1973; Young et al., 1978). There is also the issue of keeping it up to date (Sollner and Rese, 2001). To develop a sophisticated segmentation approach, one that fully identifies the specific needs and benefits of the market and client is complex and costly (Bonoma and Shapiro, 1984). More importantly, there is a lack of practical guidance or emphasise on implementation issues (Hooley, 1980). Where there is research, it lacks the understanding of 'real world' applications (Saunders, 1987; McDonald and Dunbar, 1995). Thus the situation appears bleak.

In this sense, many practitioners avoid these difficulties by using intuition rather than systematic analysis to identify segments (Wind and Cardozo, 1974). Whilst in some industries, intuition and personal experience can sometimes offer knowledge that actual

marketing intelligence may not be able to offer (Mowen and Gaeth, 1992; Brownlie and Spender, 1995), it still requires caution and should be integrated within a more formalised and measured approach (Courtney et al., 1997; Bonaneau, 2003).

The researcher has found limited research in the area of segmentation within small companies in the extant literature. Moreover, segmentation methodology is unique to one's business environment (Freytag and Clarke, 2001). To avoid applying a generalised and prescriptive approach, the researcher takes on the role as facilitator (Dibb and Simkin, 1997; Palmer and Millier, 2004) and aims to develop a method adapted to suit Eatec's situation through action learning (Weinstein, 1995; Palmer and Millier, 2004). A summary of the key segmentation models are listed in table 2.4 on the last page of this chapter.

The macro-micro segmentation models described are potentially relevant to Eatec's context. The macro segmentation stage uses characteristics such as company size and geographic location which could assist the Directors to select a set of acceptable target clients. However, in the first instance, this approach to segment by macro variables is premature in Eatec's context as clients currently span over 15 diverse market sectors. The more immediate approach as defined in the research question is to find an approach to assist the directors to evaluate and select between equally favourable market sectors.

Elements from the structured approaches to segmentation on the other hand are useful references to drive the research enquiry. Dibb and Simkin (1997) and Goller et al. (2002) offer extremely comprehensive guides and highlighted the importance of integrating segmentation within strategic marketing planning. This element is important because segmentation carried out in isolation (Goller et al., 2002) and subsequently not adopted into developing marketing plans adds very little benefit to the organisation. Both models highlight the need to predefine the need for a segmentation strategy. This helps the organisation to define what exactly they want to achieve out of the exercise. In Eatec's case, the need was already established following a background research on Eatec in chapter 1. Although these structured approaches are useful on the whole, the researcher found a lack of inspiration on the part that might show how market sectors can actually be evaluated and selected in a formalised manner.

Emerging methods that include the use of managerial intuition has been recognised as an important factor for the basis of segmentation (Mowen and Gaeth, 1992; Brownlie and Spender, 1995; Khatri and Ng, 2000; Millier, 2000). The researcher investigated the role of intuition within the literature and how it might be integrated with a structured and formalised

segmentation approach. Two dominant theories that align with utilising multi-criteria decision making along with intuition, experience and knowledge (hard and soft data) are Lockett and Naudé (1996) and Palmer and Millier (2004). The former system is a robust tool which can handle an analysis that could be as simple or as complicated as required. The advantage of the latter approach is clearly a simpler method and developed specifically for an actual problem context. As such, this would be an alternative approach for small businesses to adapt to suit specific needs (Jocumsen, 2004). The beauty of both methods is that a number of decision makers can participate. In Eatec's context, the evaluation of three Directors needs to be combined to come to an agreed decision.

The researcher therefore intends to develop a segmentation strategy built on structured approaches (Dibb and Simkin, 1997; Goller et al., 2002), and will explore the roles of MCDM and intuition (Lockett and Naudé, 1996; Palmer and Millier, 2004) through action learning (Weinstein, 1995; Palmer and Millier, 2004).

How to evaluate and choose between market segments?					
Key segmentation models analysed	Reference	Description	Summary	Suitability to Eatec's context	
Macro Micro Segmentation Models	Wind & Cardozo (1974)	Macro-Micro segmentation	These macro-micro segmentation models are potentially relevant to Eatec's context. The macro segmentation stage uses characteristics such as company size and geographic location which could assist the directors to select a set of acceptable target clients. These are useful guides to help explain to managers who are new to segmentation how to get from a premature segmentation plan to a client driven plan. However it does not show a manager how to carry out the evaluation and selection of market sectors. Eatec currently works in at least 15 diverse market sectors, each with very different types of client. The macro-micro segmentation approach described are potentially useful when Eatec has selected fewer target markets.	Now	Future
	Bonoma & Shapiro (1984)	Five layered nested model			✓
	Hague (2002)	Needs based segmentation			✓
	Dibb & Simkin (1997)	3 stage segmentation model (Now, Future and How)			✓
Structured approaches to the segmentation process			Comprehensive guide but if all selected segments are equally favourable then the managers are still faced with a difficult task of knowing how to select between the market segments. In this respect, the guide lacks practical guidance on the part which is driving this research to evaluate and select between market sectors.	✓	
	Freytag & Clarke (2001)	Multi step segmentation process	The model offers limited practical guidance in illustrating how selecting between equally favourable markets can be done. The questions are useful for decision makers to feed a discussion or debate about market sectors.	✓	
	Goller et al. (2002)	Structured and Integrated segmentation framework	Comprehensive guide very similar to Dibb & Simkin's (1997) model, but but lacks practical guidance on the part which is driving this research to evaluate and select between equally favourable markets in a structured and formalised way.	✓	
	Lockett & Naudé (1996)	Multi-Criteria Decision Making approach and Intuition based on facts and experience - through JAS	A decision based on intuition alone is not reliable. Decision making needs to be incorporated with marketing intelligence. This model can capture both data to display a rated score. For managers new to this software, a facilitator is required. Appropriate for use in context where there are many decision makers.	✓	
Managerial intuition approach to segmentation	Palmer and Millier (2004)	Multi-Criteria Decision Making approach and Intuition based on facts and experience - method developed through action learning	Matrix form of capturing evaluation data is simple to use and can be adapted to small businesses. Appropriate for use in context where there are many decision makers and all contributions need to be considered.	✓	

Table 2.4. Summary of segmentation models and frameworks

Chapter 3

Research Methodology

3.1 Research introduction

The objective of this research is to understand how decision makers can evaluate and select between diverse markets that are equally favourable to the organisation. The researcher has already established, following a review of the extant literature that this can be done effectively by exploring the roles of MCDM and intuition (Lockett and Naudé, 1996; Palmer and Millier, 2004) within structured segmentation approaches (Dibb and Simkin, 1997; Goller et al., 2002) through action learning (Weinstein, 1995; Palmer and Millier, 2004).

This chapter will describe the research approach taken to address the research question. To assess the issues of business-to-business segmentation, both primary and secondary research data collection will be required.

3.2 Justification of chosen research methodology

It is appropriate to adopt a **case study approach** for this research, which spans over the course of two years. A case study is highly complementary to incremental theory building and is useful in early stages of research on a topic or when a fresh perspective is needed. It is equally appropriate when existing theory is inadequate (Dibb and Simkin, 1997; Goller et al., 2002; Palmer and Millier, 2004) and the researcher needs to gain further knowledge (Eisenhardt, 1989).

Case studies are used as they provide a holistic view of the whole or certain aspects of a company within some real-life context and are the preferred strategy when “how” or “why” questions are posed (Yin, 1994). With the researcher having an active role within Eatec, this type of action research is academically acceptable as it aims to solve problems in a real life situation using accepted methodologies and theories (Robson, 1994). However, many also criticise it for being too subjective and unreliable. The main concern is the level of validity and reliability. Two types of validity have been raised: internal factors which could validate the cause and effect within the study (Gill and Johnson, 1991); and external factors which could affect the ability to generalise to theories or population (Robson, 1994).

General threats in validity in research design can be highlighted from the work of Robson (1994):

- Events occurred during the study
- Maturation of people during the study
- Equipments and techniques used
- Statistical regression
- Selection of respondents

The results gained from a case study research should only be generalised to theories and populations, particularly in single case designs (Yin, 1994). However, even mature topics need to start from somewhere and much of the advancement of academic theory has come from the study of small or individual cases (Robson, 1994). Nevertheless, it is believed that single cases are useful to confirm or challenge particular theories when something unusual or unexpected might be revealed (Yin, 1994). To reduce any concerns and issues of validity and rigour, the researcher will aim to adopt different ways to achieving and comparing segmentation data to identify for any gaps and similarities (Yin, 1994).

The researcher does foresee a limitation to this case study approach through action research. The output of this research is expected to be a model that can be adapted by professional services companies to assist with the evaluation and selection process between market sectors. Part of action learning is by change and improvement as part of the research project. However, the time frames involved here may not be sufficient to support the full implementation and subsequent evaluation of the success of this model (Dibb and Simkin, 1997; Goller et al., 2002), but at a minimum the case study would provide insightful learning into understanding the process of evaluation and selection of market sectors in a business-to-business segmentation context.

3.3 Planning of research design

Gill and Johnson (1991) believed that there is no one best method because of the large number of uncontrollable variables within a “real world” approach and so the choice of methodologies should be taken in the context of the research problem and the resources available to conduct the study. Indeed there are limitations to the choice of methods available, even more so in the best way to analyse the qualitative data (Shaw, 1999) since business-to-business (b2b) marketing has been partly forced to interpret its reality from allegedly general concepts and models derived from business-to-consumer marketing, which

may or may not fit the b2b environment (Gummesson, 2003). Gummesson (2003) concluded that inductive research is a complimentary strategy which lets reality tell its story on its own term and not on the terms of received theory and accepted concepts.

The chosen methodology for this research enables the gathering of good quality and rich data, which will enable greater knowledge and understanding. A combination of several other methods will also be used, such as participant observation, written sources, interviews and largely action research (Weinstein, 1995; Palmer and Millier, 2004). Reason and Rowan (1981) advocated using a combination of methods, with a real world approach. Human inquiry and action research looks at the involvement of human activities, including that of the researcher. Action research brings the researcher to be even closer to the object of study than participant observation. The researcher is immersed within the study, becoming both subjects and objects that embedded knowledge and understanding can be uncovered (Gummesson, 2003).

Whilst supporting the role of action research, Gummesson (2003) understood that it should be reserved for situations when researchers assume the role of change agents of the processes and events they are simultaneously studying. Action research has its criticisms on issues regarding validity and rigour (Eden and Huxham, 1996). However “insider research” makes use of established trust, relationships and knowledge of the organisation to conduct the research (Robson, 1994) and so it is more likely to provide recommendations that are useful to the organisation.

The ability for the research design to be flexible and responsive to unexpected incidents is important as a research progresses (Robson, 1994). There are of course values to pre-structured and emergent designs (Robson, 1994) but this all depends on the previous knowledge of the subject and surrounding topics. Issues of practicality, resource and time need also be considered which can dictate the approach used. In this study, ensuring rigour through the combination of methods whilst keeping the design flexible was met by incorporating the use of qualitative and quantitative data sources such as company documents, facts from the internet, interviews and observations (Yin, 1994). Since the case study method is a flexible technique that can be used effectively in a variety of formats as part of a teaching and learning process (Zimmerman, 2002), when variables and issues are discovered, these can be incorporated and reviewed in the research design to accommodate the change that incurred.

3.4 Research success factors

Dibb (1998) argues that although there is a lack of quantitative research on the question of segmentation success factors, some qualitative contributions have been made to the debate. For example, well designed planning (Weinstein, 1987), commitment and involvement of senior managers (Engle et al., 1972), choice of segmentation bases (Coles and Culley, 1986), readiness to respond to market changes (Brown et al., 1989) and creative thinking (Weinstein, 1994) have all been cited as potential success factors.

Reason and Rowan (1981) demonstrated the correlation between different types of workplace research (table 3.1).

	Types of research		
	Basic research	Applied research	Participative research
Research goal	Abstract general knowledge (context-free knowledge)	Solutions to work place problems (context bound knowledge)	Local theory - actionable and generalise (content bound knowledge)
Who learns from the research in the first instance?	The social science community (usually, but not usually exclusively other researchers)	The client (usually but not exclusively management)	Participants (usually but not exclusively workers and researchers)
Likelihood that those who supply the data will use the results	VERY LOW	LOW	HIGH
Relation between researcher and researchee(s)	Theoretician	Expert	Colleague
	↓ Object	↓↑ Client	↓↑ Colleague
Researcher role	Producer of distant learning	Producer of organisational change	Co-producer of learning

Table 3.1. Different types of workplace research and its contributions (Reason and Rowan, 1981)

This research falls in the participative research column. This is the required approach in this study because the researcher is producing appropriate segmentation strategies as more is learnt about the company. This will involve the directors at Eatec and is an approach that will enable the integration of work actions as well as researcher goals. As Robson (1994) argued, the depth of understanding gained about the organisation at a realistic level from the researcher's point of view assists with the understanding of the context and practical recommendations developed. Researchers need to build trust and define themselves in the same environment, experiencing the same reality with the people in the organisation. Hence, any actionable theory developed needs to mean something to them relevant to their world on their terms (Reason and Rowan, 1981).

Segmentation success is determined by applying the right choice of approach to the company (Coles and Culley, 1986). However, the researcher has already established in the literature that a segmentation methodology is unique to one's business environment (Freytag and Clarke, 2001). For Eatec's context, the best segmentation approach is not definable until the researcher has gained further knowledge and understanding of the business context. This learning can only be gained through participating in the day to day of Eatec's working life. This strengthens the justification of the chosen methodology and to develop an appropriate segmentation strategy through action learning. The researcher is not implying that one should instigate a segmentation approach on a blank slate. A review of the extant literature on the research topic will provide the opportunity to appraise theoretical models and to build a more detailed understanding of segmentation process. This enables the researcher to create a robust research question or ideas to test that are relevant to the research company. As a result of a literature review, the researcher has developed further understanding of the research topic (b2b segmentation) and has adopted some ideas that could be built on structured approaches (Dibb and Simkin, 1997; Goller et al., 2002) using multi-criteria decision making and intuition (Lockett and Naudé, 1996; Palmer and Millier, 2004) to drive the research query.

Gummesson (2003) stressed that b2b researchers should not be bureaucrats and administrators of regulated research rituals. The process of qualitative data analysis is eclectic, there is no "right way" in carrying out qualitative research methods (Cresswell, 1994). A combination of methods aids the research design to be flexible and responsive to unexpected incidents as a research progresses (Robson, 1994). Brown et al. (1989) suggested readiness to respond to market changes as a factor to successful research, but since this is a research in the "real world", it inevitable that uncontrollable variables will exist such as "changing of minds" or "gut-feel". The readiness to respond to human changes is also a major factor particularly in action research. Reason and Bradbury (2001) define action research to be concerned with day-to-day experience. In many ways the process of human inquiry is as important as specific outcomes. In action research, knowledge is a living, evolving process meaning it cannot be programmatic, and thus subject to change. Therefore, action research is a way to help researchers understand how social change is influenced, and through this developed understanding, the researcher can better evaluate his work and change it as necessary (McNiff, 2002).

McNiff (2002) advocated using a combination of methods with a real world approach. Action research is often referred to as practitioner based research; and because it involves the researcher thinking and reflecting on the research work, it is sometimes referred to as

self-reflective practice. Therefore, an integral part of the action research process is to demonstrate a development in the researcher's own thinking and learning. Reflection is the key to successful implementation of the strategic marketing and segmentation plan. Reflection and theory, in contrast to experience are 'motors' which drive the learning cycle (Caple and Martin, 1994). This is demonstrated in Kolb's learning cycle (1984) in figure 3.1.

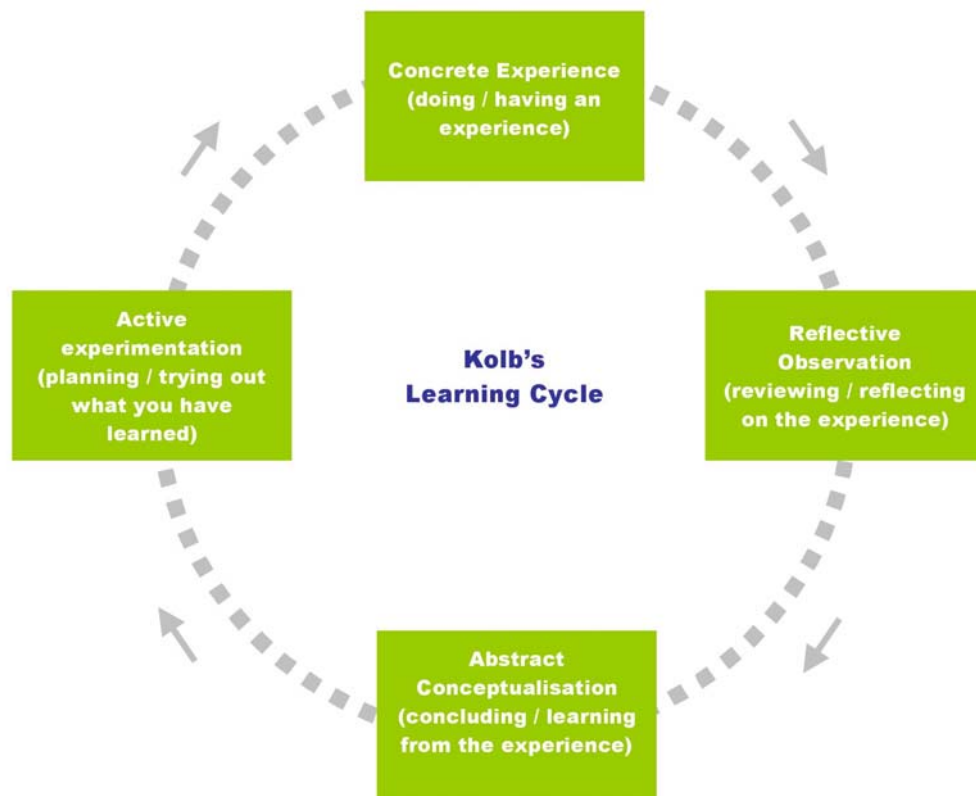


Figure 3.1. Kolb's Learning Cycle (1984)

The researcher will endeavour to illustrate the learning gained from this action research using Kolb's model (figure 3.1) in the thesis discussion.

3.5 Data collection methodology

Both primary and secondary research and data collection will be required. Two key research methods will be employed:

- Participant observation
- Semi-structured interviews

Secondary data is collected from past company reports to define which market sectors Eatec had previously worked in. It will also be collected from secondary resource such as journals and the Internet to retrieve information about the different market sectors. But the vast majority of data will be primarily collected from meetings and discussions with the management team throughout the process. Other sources of qualitative data collection will include talking to industry professionals and meeting selective clients of the company.

3.5.1 Participant observation

As a new member of staff, the researcher felt that participant observation is a useful tool in the initial stages. This is to avoid staff feeling threatened by an outsider coming into their workplace and making a whole lot of change. Before developing a strategic plan and to ensure its success, Johnson and Scholes (1993) warned SMEs that the managers and the culture within must be able to identify and cope with the change. Therefore, it is important for the researcher to introduce the purpose of the Knowledge Transfer Partnership programme in which the researcher is employed into. An early introduction and clarification would help ease any feelings of uncertainty amongst staff. It can also help to avoid misunderstanding about the researcher's role, which is predominantly to help the company define and implement a segmentation strategy to assist with targeted company growth.

Richardson (1995) agreed that planning in an SME should be taken in a series of steps including setting objectives, communicating aspirations, analysing the environmental situation (present and future). Sanger (1996) wrote that participant observation aims to explore cultural understanding, contexts and general assumptions but the presence of an observer would affect activities and behaviour, and therefore should be considered a variable. However, this variable was limited in this research because the researcher was considered by members of staff to be a part of the working team.

Data was collected mainly by descriptive notes. In a case study, analysis is a continual process which shapes the emergent design (Robson, 1994). DeWalt and DeWalt (2002) summed up the elements of participant observation. The elements that were applied to this research and how it was applied have been highlighted in table 3.2.

Elements of participant observation	Applied to research	How element was applied to research
Living in the context for an extended period of time	✓	Employed as member of staff on a two year contract
Learning and using local language and dialect	✓	Researcher had training to understanding engineering jargons
Actively participating in a wide range of daily, routine, and extraordinary activities with people who are full participants in that context	✓	The researcher was embedded within the research context by working as a member of staff in the same open plan office by same office hours
Using everyday conversation as an interview technique	✓	Communication by conversations and emails
Informally observing during leisure activities	✗	Not applicable
Recording observations in field notes	✓	Note taking was constant by means of informal notes and minutes of meetings
Using both tacit and explicit information in analysis and writing.	✓	Both qualitative and quantitative information was used as part of the research

Table 3.2. Elements of participant observation (DeWalt and DeWalt, 2002)

3.5.2 Semi structured interviews

Interviews are conversations with a purpose (Robson, 1994) and are a very useful method for finding answers to specific questions. Walker (1985) wrote that in planning interviews, the following factors would need to be considered:

- Degree of structure
- Potential interviewer bias
- Social and questioning skills
- Access to participant
- Trust of participants

In this single case study environment, it is appropriate to adopt semi-structured interviews because the participants' response could then be further explored if it highlighted interests to the researcher. Furthermore, it is also useful to initially screen out participants that may not

be the right person to speak to. Brace (2004) emphasises that a questionnaire is most commonly divided into three sections: exclusion, screening and then the main questions. This level of structure would be appropriate where the researcher would need to speak to participants from various market sectors in the early stages of the research. A structured interview would be too rigid and would not complement an action learning approach, but having the interviews semi structured elicits the participants' to think about issues with which the researcher is interested in and altogether less constraining (Bryman and Bell, 2004).

The potential of interviewer bias was limited because the researcher had limited knowledge about the subject of segmentation. The aim on the researcher's part is action learning with the help of academic resource from the University of Bath. Therefore, the researcher's main interest was to report all parts of the research findings, which would eliminate interviewer bias.

Having semi-structured questionnaires helps with questioning skills such as probing on responses to a specific question. For interviews that will be carried out with professionals who are not a part of the research company, the researcher can adopt the role of an academic researcher in which the participants' response contributed to an academic research. This is likely to help with the social elements of the interviewing because participants would be more likely to warm to the prospect of assisting with academia contributions than to assist a private sector company whose aim was to gather research for its own business development plans. However, an ethical approach with respect to data collection needs to be adopted and this involves trust.

Hunt et al. (1984) wrote that a researcher has the responsibility to treat participants fairly in a research study, whilst at the same time a researcher has a responsibility to the client to gather accurate, reliable information. This causes an ethical conflict and Hunt et al. (1984) stated that the researcher must attempt to resolve these opposing obligations. Bartels (1967) wrote that because there are so many expectations to be met, the researcher needs to maintain a balance of obligations and satisfactions. To satisfy the expectations of all parties would be most ethical but unlikely to be achievable because expectations are often contradictory. Hence, the researcher would need to adopt skills and judgment in order to reach a point where self-integrity could be best maintained.

In order to resolve this ethical conflict, the researcher would brief the participants about the nature of this research, which is to understand more about business-to-business segmentation

process in a small professional services company, with the aim to achieve an MPhil research degree. The participants would therefore be aware of the researcher's involvement in carrying out research within a company (thus satisfying obligations to be truthful to the participant). Only upon achieving an MPhil degree would the researcher have fulfilled her duty to the participants (whom initially agreed on assisting based on the fact that they were contributing to the completion of a postgraduate research degree).

Access to participants is made easy because the researcher is a member of staff and the directors permitted access to all staff enabling the researcher to contact people as and when necessary. However, the early stages of research would require the researcher speaking to people from outside of the company in different market industries to develop marketing intelligence. This information would assist the directors with sector evaluation during the segmentation process. Access to such participants would depend on the secondary data retrieved from an Internet search and then the researcher conducting interviews over the telephone with industry professionals who are willing to assist with the research. Cold calling can be intimidating but it is a useful way to obtain primary data from someone who works within a market sector where the researcher had no access.

Obtaining the trust of participants and in maintaining an ethical approach to research with respect to data collection is important. As well as carrying out researcher ethical obligations, Greene et al. (1994) stressed that professional imagery was important in the application of internal marketing. Marketing one-self in a professional manner during the research was important. After all, the researcher was asking the potential subject for his time to contribute to the study, which was something the subject was not obliged to do, but out of goodwill. Greene et al. (1994) wrote that before one ever has an opportunity to develop a professional image, other forces have already begun to shape that image. Factors which influence first impressions include referral sources, comments of existing customers, marketing literature all have an impact on shaping what the prospective client will perceive when he/she finally comes face to face. Even the receptionist, often the first person the prospective client will meet, can have an impact on impression.

Hence, friendliness, professional demeanour and helpfulness all play a part in a company's professional image. When face-to-face meetings are not convenient, telephone etiquette is a critical ingredient in contributing to this first impression and strongly applies to this research in such a cold calling situation.

3.6 Communication and analysis of data

The Directors at Eatec will be kept fully informed of progress and findings on a regular basis. The researcher will set up monthly project review meetings where a member of the academic staff from the University of Bath (with experience in this field) will also attend to offer additional guidance and advice.

In the analysis stage of the findings, it is important to reflect on the approaches chosen to underpin this research:

- A **case study approach** aims to focus on the meaning of the findings that are unique to that company only. This approach is selected for Eatec's context to gain useful insight into the process of evaluating and selecting between market sectors where the extant literature provided minimal practical guidance.
- An **action research** can develop practical solutions through practical research
- Through **participant observation and interviewing techniques**, the direct involvement of the researcher would require a level of objectivity. The 'open-format' of semi-structured interviews will produce a range of non-standardised information that will be difficult to assimilate and conclude. The researcher would need to digest the information objectively to uncover those factors that directly relate to the process of evaluation and selection of market sectors during the segmentation process.

The researcher will evaluate qualitative information to build a clear picture of the process of evaluating and selecting between equally favourable market sectors in a business-to-business organisation. Where quantitative data is captured, the researcher will present these through tables, graphs and figures.

Chapter 4

Segmentation Process

4.1 Introduction to the primary research

The research methodology proposes that a case study approach is used so that a holistic view of the segmentation process can be reported in a real-life context (Yin, 1994). To do this, the researcher revisited the knowledge captured during the literature review to prepare an approach that would help structure the research query. The researcher finds elements from both comprehensive models offered by Dibb and Simkin (1997) and Goller et al. (2002) useful but it is the latter structure that the researcher can easily adapt to Eatec's context.

The stages of the research are illustrated in figure 4.1. Before the research question could be addressed, the Directors needed to clarify the company objectives. To help establish objectives and subsequent business strategies, they needed to develop a clear understanding of the company's internal and external environments. A PEST and SWOT analysis falls neatly in this stage. Gaining an understanding of the external markets required the researcher to carry out several market sector research through secondary data analysis and where possible, primary data analysis. Information gained at this stage will help influence the decision making process when evaluating and selecting target market sectors. This is represented in figure 4.1 in stage 1 referenced as **'before segmentation'** and is discussed in section 4.2. The extensive report of the PEST and SWOT analysis and market sector reports are not included in the main body of the thesis as it would deter from the main research objective. It is however included in appendix 1 and 2 for further reference. Stage 2 of figure 4.1 referenced as **'during segmentation'** directly addresses the research question on how to evaluate and select market sectors. In particular, when market sectors are equally favourable, the need for a segmentation approach is even more relevant. A significant element of the research is action learning. This means that the research question will be addressed as the process to evaluate and select market sectors evolves. This process is discussed in section 4.3 which follows the development of a structured approach to segmentation. Problems were unfolded and the researcher discovers the need to develop a revised segmentation approach. The lessons learnt from this stage are unveiled in the summary to section 4.3. The researcher remained at Eatec until the end of stage 3. Whilst the findings developed at this stage are useful to managers to understand segmentation within the broader rubric of a strategic marketing plan, it would be misplaced in the context of the research question which is to understand the issues involved in b2b segmentation. The implementation write up is not included in the main body of this thesis but is provided in appendix 3 for further reference.

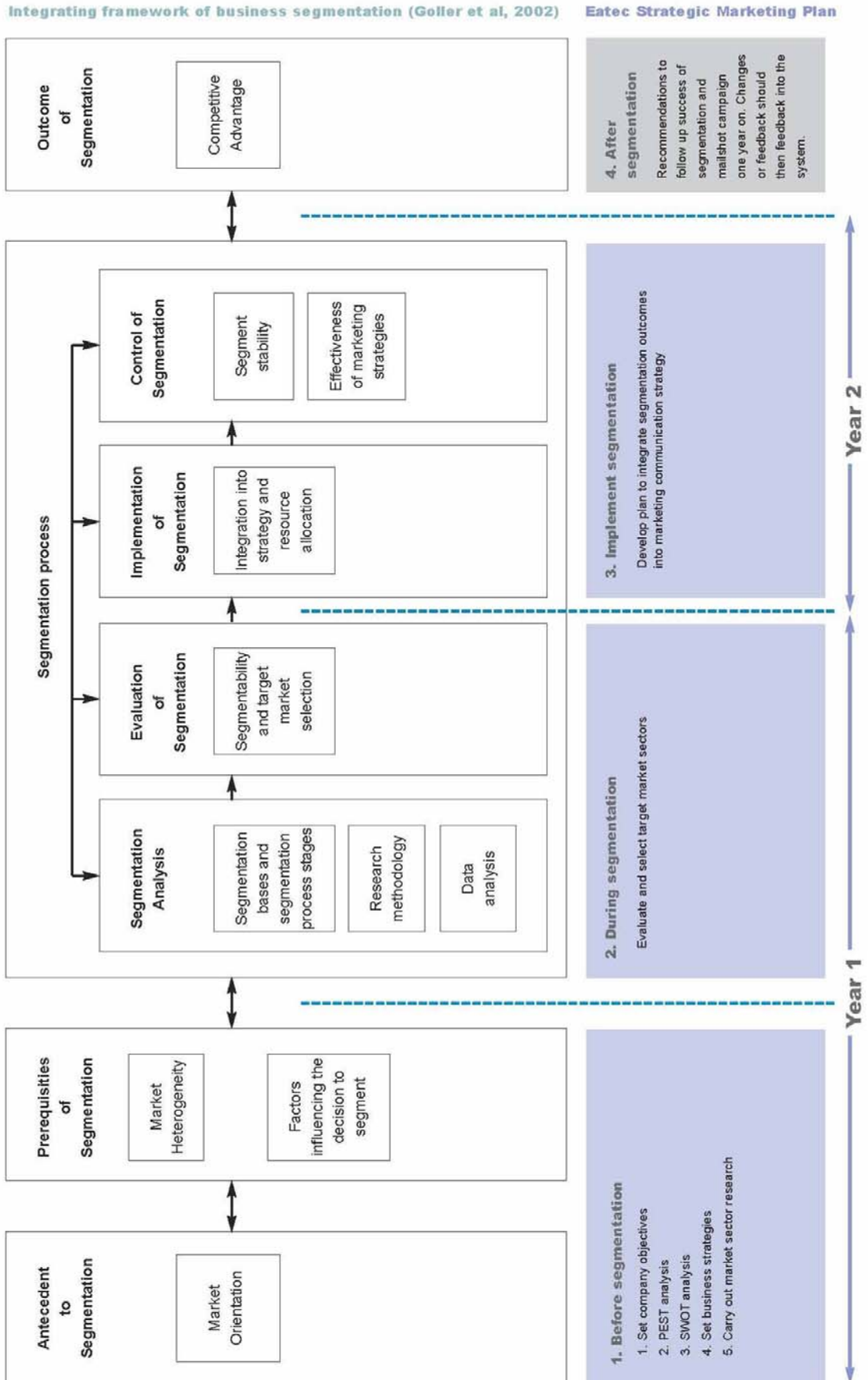


Figure 4.1. Eatec's strategic marketing plan in alignment with Goller et al. (2002) integrated framework of segmentation

4.2 Before segmentation

This section covers the prelude to Eatec's segmentation process. The researcher started in the company understanding that a segmentation strategy was required as a logical approach to subsequently define appropriate marketing activities to aid company growth. Through discussions, the researcher uncovered that the directors worked in diverse market sectors. Although they were able to pinpoint a few key market sectors (Oil & Gas and Rail), the majority of their business was developed on an opportunistic basis and hence their work is immersed in a wide range of market sectors with no particular focus.

From the researcher's background understanding discussed in chapter 1, there were at least 15 market sectors involved. Over lengthy meetings with the directors, it was agreed that this list needs to be reduced down to a manageable few. It was obvious that some market sectors could be easily discarded given the size of their contribution to turnover (see figure 1.3 and 1.4). However, the directors could not agree on deciding which market sectors should stay or go because there were conflicting opinions on what makes a market sector favourable over another. The key factor at this stage was that the directors had not even established company objectives in which to base their debate on.

4.2.1 Setting company objectives

Kotler and Keller (2005) argue that in evaluating different market segments, the firm must look at two factors: the segment's overall attractiveness and alignment with the company's objectives and resources. A potential segment would have certain characteristics that make it generally attractive, such as size, growth, profitability, scale economies, and low risk. Some attractive segments could be dismissed because they would not align with the company's objectives in the long-run, or that the company lacks one or more necessary competences to offer superior value within that market segment.

It was therefore important to establish company objectives so that directors were clear on company aims and directions. In fact, given the small size of the company, the directors encouraged all staff to participate in the brainstorming sessions in which the researcher facilitated (Dibb and Simkin, 1997). These brainstorming sessions were useful to provide staff with a sense of involvement in the process of developing a segmentation strategy. Through participant observation, the researcher noted that staff took to these moments as an opportunity to express feelings of discontent about the company's lack of investment in personal and professional development, as well as insignificant software capabilities in-house.

Whilst these sessions were clearly set up to discuss company objectives, some had felt that a lack of investment in personal and professional development an issue which would hinder the company's development. It was interesting to observe that staff had felt comfortable raising these concerns in an open discussion rather than in individual staff appraisals, which might have been a more appropriate forum to discuss training issues. This was understandable. To raise such issues in a staff appraisal would have meant that an individual was vulnerable and justification would have been required for the company to invest the requested amount of training budget for personal development.

The researcher had observed that each individual was not particularly open to conversations which reflected in the general working atmosphere to be extremely quiet. However, the researcher was surprised to observe that all staff contended with each other when the subject of training was discussed and most spoke out regarding this issue. The researcher noted the company objectives and provided a summary listed in table 4.1.

1	To increase sales by a minimum of 20% per annum
2	To maintain a profit (Net profit before tax) level of at least 15% of turnover
3	To reduce dependence on main clients
4	To obtain additional clients with ongoing requirements and with reasonable research/development budgets and growth prospects
5	To target more challenging requirements where cost is less important rather than enter the market for routine work
6	To use our long term relationships to broaden our experience and expertise
7	To be perceived as a high quality, accurate, reliable and comprehensive solver of problems
8	To make a significant investment in personal and professional development of staff
9	To significantly improve our software capabilities
10	To consider grant aided research projects for technical interest provided they have a commercial potential
11	To gain ISO 9000 accreditation

Table 4.1. Company objectives

The directors now felt that they had something tangible in which to anchor their thoughts onto when deciding what makes a market sector attractive to the company. That is, if that market sector has potential for Eatec to achieve the agreed company objectives, then it is a target market sector worth considering.

4.2.2 Internal and external environmental analysis

In order the directors gain a holistic view of Eatec's current situation, as well as defining company objectives, it was felt an internal and external environmental analysis would be beneficial. Brooksbank (1999) stated that successful strategy development is about finding the fit between the firm and the competitive environment. Such factors need to be analysed in order to identify new opportunities or threats emanating from the wider world. This analysis was carried out using a SWOT and PEST analysis.

The researcher facilitated the agenda and discussions of the meeting where all staff and directors attended. With the researcher taking a participative observation role, all discussions generated during these meetings were recorded and summarised in appendix 1. These notes assisted with the overall managerial decision-making and are valuable to the company. However, to include them in the main body of the thesis would be misplaced in the context of the research query.

4.2.3 Setting business strategies

The directors have now established company objectives with a clear picture of the internal and external environment; the antecedents to segmentation (Goller et al., 2002). The prerequisite to segmentation looks at the factors that actually influence the development of the segmentation process. As such, the next steps were to define Eatec's business strategy. One of the top priorities defined in the company objectives was to increase business by 20% per annum. The directors wanted to debate and agree how they were to achieve this.

The researcher facilitated another brainstorming session for directors and staff to debate over various potential business strategies. In these meetings, the agenda was to discuss possible business strategies, taking into consideration the agreed company objectives, along with the PEST and SWOT issues defined earlier. The discussions took a few hours with the researcher recording and collating data. Upon concluding the discussions, five business strategies were defined. It was agreed by the directors that it was not possible to carry out all five strategies. Therefore, voting took place to prioritise one strategy. This was an important step preceding the segmentation process because it would ultimately influence the development of a segmentation strategy. The five business strategies developed as a result of the discussions are listed below:

<p>Strategy 1 Concentrate on three market sectors.</p>	<p>All relevant and new market sectors would be researched evaluated and selected. Subsequently, Eatec would still pursue existing leads and contacts. Progress with the selected market sectors would be reviewed frequently, and appropriate marketing communication campaigns would be developed. An awareness of developing markets need also be maintained.</p>
<p>Reason for strategy</p>	<p>Attempting to promote Eatec to all industry sectors would be difficult and would result in a lack of focus in the company's promotional activities. At this time it was felt appropriate to limit focus on three sectors.</p> <p>By concentrating on a few industry sectors, Eatec would be able to develop a more detailed knowledge of client requirements.</p> <p>A ranking exercise would need to be performed to find out the possible market sectors Eatec could address. These market sectors would need to be significant in size, require a range of services we offer, undertake research and assessments, and are not too cost conscious. Eatec would also need to have experience in these target sectors.</p>
<p>Implications for Eatec</p>	<p>Most of the marketing would be directed at the selected industry sectors. If it does not work out then the directors would need to review the approach.</p> <p>Eatec would continue to work for existing clients in other sectors, and would still respond to business enquiries. Eatec would continue to be opportunistic.</p> <p>By concentrating on a few sectors, the variety of works may diminish, but it could grow if Eatec moves into providing new services or new applications of existing services.</p>

Strategy 2 Concentrate on companies who undertake research	These companies undertake research to enhance future products, or require problem-solving skills (e.g. following in service failures). These companies could come from any market sector, but it is possible that some sector would have a greater market for the services we offer.
Reason for strategy	<p>Eatec offered a range of skills and services which meant a reasonably wide range of problems to be addressed. The number of organisations offering the range of services required to undertake research / problem solving is smaller, and are likely to have similar charging rates to Eatec</p> <p>The work tends to be of a more challenging nature, and generally the clients less cost conscious. All of the services currently offered would be relevant for this type of work. Eatec has considerable experience of undertaking this type of work successfully, and hence can demonstrate a track record.</p>
Implications for Eatec	It was difficult to identify those who have a need for Eatec's services across a wide range of market sectors, and hence targeted marketing would be difficult, or would require considerable research (perhaps by technical people). It would be necessary to develop new skills or work with other organisations in order that Eatec can fully address the requirements of some projects. In-service problem solving could be of a short or long term nature, but research is more likely to be of a longer term nature.

Strategy 3 Concentrate on companies needing assessment services	These companies could come from any market sector, but with Eatec's experience it would be possible to identify sectors which have the greatest requirement for these services.
Reason for strategy	Eatec has considerable experience of this type of work, and hence can demonstrate a considerable track record.
Implications for Eatec	<p>There is growing competition from other consultancies, and more companies have in-house capabilities, or use on-site contractors. This would result in pressure on charging rates.</p> <p>In order to enhance Eatec's success, the company would need to distinguish itself from other consultancies by providing more advanced services (e.g. fracture mechanics, advanced fatigue predictions). Concentrating on assessment services is unlikely to result in significant amounts of general mathematical modeling / simulation work.</p>

Strategy 4 Sell company	Sell the company to a much larger organisation or Consultancy.
Reason for strategy	With Eatec's extensive knowledge of the drill bit industry, it may be attractive for a supplier or consultancy to incorporate Eatec in to its own research group. With respect to the purchaser, they would ensure that Eatec's knowledge and experience could not be acquired by a competitor.
Implications for Eatec	<p>Eatec would obtain greater security and continuity of work. The company would become part of the purchaser's research group and hence more able to influence the direction and scope of the work.</p> <p>The activities Eatec could become involved in may grow as more groups within the organisation who have different requirements made use of Eatec's resources, skills and experience. Eatec would become controlled by others, who would ultimately decide what activities should be pursued.</p>

Strategy 5 Develop links with design consultancies and test houses	This would benefit external companies in that it could claim to offer more services, and it would benefit Eatec in that it would generate leads for the company.
Reason for strategy	Some of the clients in test houses and design consultancies were likely to have a need for services of the type we provide. By developing links with these types of organisations, Eatec could obtain good quality leads. The increased range of services Eatec could claim to offer would be of benefit to marketing. In addition, Eatec may pay for a finder's fee.
Implications for Eatec	<p>Eatec would have to invest time in developing and maintaining relationships with the test houses and design consultancies. Eatec would need to be confident about the professionalism of the other company, otherwise it could end up with a damaged reputation through their actions.</p> <p>Eatec may develop more knowledge of other types of companies which require testing and analysis/simulation services.</p> <p>This information would assist with the company's market awareness. It is unlikely that Eatec would be able to refer much business to the other parties, and hence the relationship would be one-sided. Therefore, in order for the relationship to develop, Eatec would need to make payments for leads which generated business for the company. This would need to be high enough that the other company was motivated to promote Eatec's type of work and to pass on leads. However, this would increase Eatec's costs, or add the cost into the proposal, making Eatec less competitive with others tendering for the work.</p>

The voting consensus was to pursue business strategy one. With respect to the chosen business strategy, which was to concentrate on 3 market sectors, the discussions here are relevant to the research query, and therefore strengthen the need to investigate how market sectors can be evaluated and selected as defined in chapter 1.

4.2.4 Carrying out market research

For the Directors to evaluate and select target market sectors effectively, it was acknowledged that some background knowledge on each market sector was required. The options which took place at this stage were to:

- define market sectors to research
- research market sectors through primary and secondary data

Out of the 15 diverse market sectors (figure 1.3 and 1.4), 10 market sectors were selected which fulfilled the following criteria:

- the company had prior experience in that market
- Eatec's engineering design skills (those listed in table 1.1) could be applied to engineering problems within that market
- Represented a fair percentage of income share

These market sectors are:

- 1) Aerospace
- 2) Automotive
- 3) Consumer Goods
- 4) Defence
- 5) Expert Witness
- 6) Medical
- 7) Monitoring of transportation
- 8) Oil and Gas
- 9) Processing (food and paper processing but analysed as separate markets)
- 10) Rail

The researcher carried out an exploratory market research on each of the 10 market sectors which aimed to assist the directors with the evaluation and selection of the target market sectors.

Although market research is costly and time-consuming, up to date marketing intelligence gained from the task are particularly useful to the directors where new sectors were involved. This provides some concrete information to aid the Directors' decision making in the segmentation evaluation process.

The key element of the market sector researches were through secondary data source. Reviewing secondary data such as industry journals and internet sources provided a general understanding of the market concerned and the general skills adopted within that field. This was useful for the researcher to gain a general background understanding of the relevant market sectors before carrying out primary data research through interviews.

Interviews are conversations with a purpose (Robson, 1994) and so the researcher had to define that purpose with the directors. The researcher facilitated a meeting with the directors to develop a brief so that a suitable questionnaire could be developed for the market research. The directors highlighted 6 factors which would influence their judgement on a market sector upon deciding its attractiveness to Eatec. These factors assisted with the development of appropriate interviewing questions as shown in table 4.2.

Exploratory market research brief	Questions developed for the market research
1. determine if the markets face key design or engineering problems	What are the key designs and engineering problems you face?
2. determine if the company has ever used advance engineering technique in research and design	Have you used any advanced engineering techniques in the research, design and development stages?
3. determine if the company have in-house engineering consultants or outsourced	Do you have engineering consultants in house or outsourced?
4. determine any new techniques or applications within the industry	Which do you feel will be the new techniques and applications offered by consultants/contractors, which will be used increasingly in the future in your industry?
5. determine various media channels for marketing Eatec	Which are the most important trade journals in your industry, which would be read by decision makers etc?
6. determine participants' expectation on industry charge rates for such professional engineering services	What do you think would be the typical price paid per day/per hour in your industry for the sort of consultancy/contractor services we have been talking about?

Table 4.2. Exploratory market research brief and questions developed

Referring to table 4.2, questions 1 and 2 are exclusion questions. If in general the overall participant within a particular sector did not face engineering problems or ever use advance engineering techniques, then there was little reason in carrying on with the questionnaire.

Question 3 was a screening question. With the researcher having confirmed that engineering problems were encountered, and/or that the participant did use advance engineering techniques, the researcher needed to determine what type of company outsourced or considered outsourcing. If the overall participant generally carries out engineering in-house, then that type of company can be screened out from the selection process.

Questions 4, 5 and 6 were the main questions of the questionnaire having screened out irrelevant companies through the earlier questions. Question 4 looks at potential new areas

within that market, question 5 looks at the marketing aspects and question 6 looks at the financial implications.

Surveys were then carried out with professionals in each market sector where possible through telephone or face-to-face interviews. Each of the market sector research took approximately 2-3 weeks to complete. Interviewing as part of the research methodology was described in chapter 3. The responses generated from these questions are incorporated into the market sector analysis reports included in appendix 2.

4.2.5 Key outcomes from the exploratory market sector research

As a result of the exploratory market research, it was agreed by the Directors that Expert Witness and Monitoring of Transportation should not be classified as market sectors but rather a skill that could be offered to clients across market sectors. Eatec worked on one expert witness case in the marine sector and from this experience realised there was potential to expand this offering to other sectors. Although an attractive sector, the company did not have sufficient expert witness experience or time to invest on building credibility at this stage to offer it as a definitive company skill. Therefore, it was agreed that this skill could be offered on an opportunistic basis. Subsequently expert witness was removed from the list of defined market sectors.

For Monitoring of Transportation, the directors' response was that this skill or service was really only applicable to the consumer goods industry. Therefore, Monitoring of Transportation was subsequently removed from the list of market sectors but instead added to the list of in-house service offering. This was because the directors were keen to see if other market sectors demanded this service as well. More importantly, unlike Expert Witness which required time to build up the company's credibility, providing monitoring of transportation required little start up cost as the technology for monitoring transportation was already designed in a previous job Eatec was involved in and thus the instrument and analysis could be adapted to project work in different sectors. As a result, Eatec had the capability to offer monitoring of transportation as their skill, a potential service offering to clients.

Although the exploratory market research provided the directors with useful background on the initial ten market sectors (Expert Witness and Monitoring of Transportation, both subsequently removed which leaves eight selected market sectors), this only adds to the impediment of selecting between equally favourable markets. Each Director generated their

own views on each of the market sectors following the market sector analysis but each Director also contended with their own intuition. At this point, we now come to address the core of the research query. An evaluation method needs to be developed so that each Director can adopt both their views on the information gained from the market research along with their own intuition. Ultimately, the judgement developed from this can be captured in a calculated way.

4.2.6 Lessons learnt from stage 1 ‘before segmentation’ phase

The researcher and the Directors lacked experience in creating functional plans from a marketing aspect. Whilst monthly meetings were held with an academic representative in the field of marketing to offer ideas and guidance, the process took longer than expected.

Unfortunately, carrying out market research was an inevitable process to gain concrete data which contributed to segmentation evaluation. Due to this long winded process, enthusiasm waned. Seven months into the two year marketing contract, the Directors and those involved realised that no plans had been done to evaluate and select appropriate markets. With the summer holiday period coming up, it was foreseeable that the process was to be delayed further, and thus with a little over a year to complete the segmentation process and subsequently to define appropriate marketing strategies, time was not of the essence.

In this case, since the contract time was limited to two years, more time should have been placed in planning for stage 2 and stage 3, the segmentation and implementation phase. This is not to say that market research should be neglected, as we know that this was necessary, particularly for the directors to understand the new markets. However, a marketing budget was in place and financial resource should have been allocated to outsource the market research. This would have freed up the researcher’s time to concentrate on planning the segmentation and implementation stages with the Directors and those involved.

A brief financial plan could have been introduced to allocate budget to certain parts of the strategic marketing planning process. This would have avoided the Directors’ fear of spending too much of the budget upfront leaving little for ‘later’, as it was realised later on in the process that there was still a large amount of budget that remain unused.

4.3 Segmentation process

4.3.1 A structured approach to segmentation

To facilitate the segmentation evaluation and selection process, the Directors were introduced to JAS, a judgemental modeling tool, which enables multi-criteria decision making (MCDM) to assist them with choosing between the 8 market sectors (Saaty, 1980; Islei and Lockett, 1988; Lockett and Islei, 1989; Lockett and Naudé, 1996).

The Directors discussed at some length the attributes of the market sectors. The agreed attributes (table 4.3) were used by each Director to evaluate the attractiveness of each market sector with each service that the company offers.

Attributes of the market sectors
1. Size of the market for the type of services that Eatec offers
2. Growth of the sector
3. Extent of technological competition in the sector
4. Eatec's prior experience in the sector
5. Number of medium sized companies
6. extent to which the segment requires consultancy rather than contractors
7. Extent to which the industry is cost conscious
8. Extent of Eatec's expertise which is relevant to the industry
9. Intensity of competition to Eatec

Table 4.3. Attributes agreed by Directors

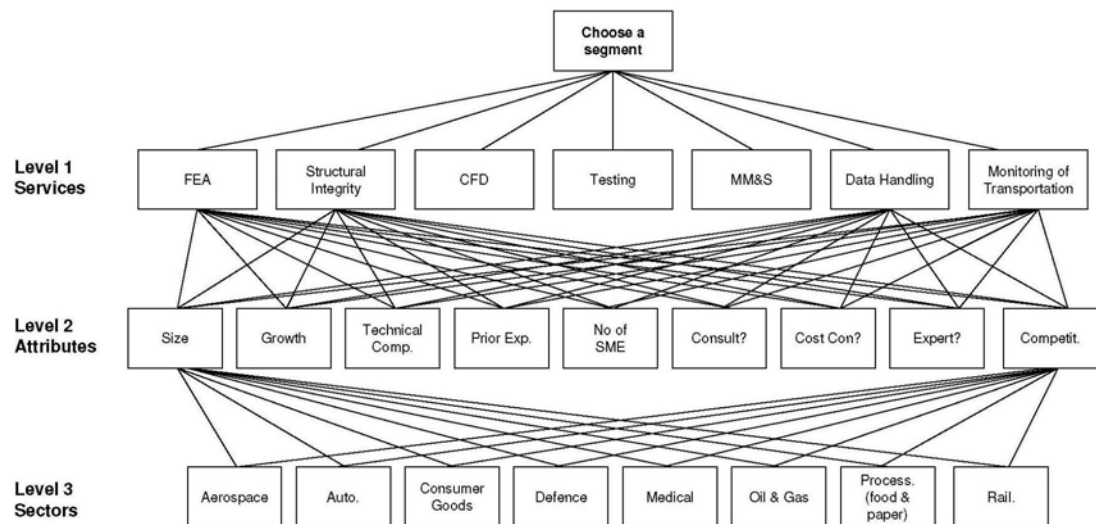


Figure 4.2. The Decision Matrix

Figure 4.2 illustrates the complex but highly structured nature of this decision making process. The relative importance of the nine attributes shown in level 2 was evaluated. This was to determine the extent to which the three directors agreed with each other in respect of attribute importance as well as to check for major discrepancies. It also gave the Directors a chance to familiarise themselves with using JAS. The Directors then evaluated how each of the eight potential market sectors, shown in level 3 scored against these same attributes.

Attribute Description	AB		CD		EF	
	Score	Rank	Score	Rank	Score	Rank
Size of segment	5.9	5	1.6	9	1.8	8=
Growth of segment	11.8	3	4.8	8	1.8	8=
Extent of technological competition	8.0	4	9.5	6=	8.8	5=
Prior experience in the segment	29.6	1=	17.5	2	17.5	1=
No. of Medium Sized Companies	4.7	6=	15.9	3	17.5	1=
Extent to which consultancy required	4.7	6=	11.1	4=	17.5	1=
Extent of cost consciousness	2.4	8=	9.5	6=	8.8	5=
The company's relevant expertise	29.6	1=	19.0	1	17.5	1=
The Intensity of the Competition	2.4	8=	11.1	4=	8.8	5=

Table 4.4. The attribute weights

Table 4.4 highlights that there are clear differences and similarities in the Directors' perceptions: all three regarded their company's relevant expertise and the level of prior experience as the two most important variables, although the weight allocated varied considerably (17.5 to 29.6 in both cases). For all three Directors there were a high number of equal scores, with Director EF effectively using just three different weights. This initial comparison suggests that the Directors do each have different perceptions on the importance of each attribute. Since Directors have differing opinions, this emphasises even more the importance of having JAS to do the background calculating so that the decision makers can independently come to set agreements of criteria. Without it, the Directors could be debating endlessly amongst themselves on what is important and what is not. Hence, set agreements of definitions and scales are defined and then used to evaluate and select between various market sectors so that decisions are made based on common understanding.

The next step involved each Director scoring each of the eight market sectors on each of the nine attributes. A pilot test was initially carried out using JAS before pursuing the full analysis for all seven services and eight market sectors. This was to ensure that the Directors understanding of the weighting scale was consistent and that the MCDM approach provided helpful and meaningful results.

The learning developed from the process was valuable as the researcher now realises that a simpler form of evaluation and selection method was required but one that incorporated the benefits of JAS. That is, enabling the use of intuition in the MCDM process and one that the directors can use independently. Each Director carried out the pilot exercise for just three of the services (finite element analysis, testing and monitoring of transportation) against the eight market sectors. The findings were checked to see if the results were more or less in alignment. The services chosen for the pilot stage were those in which Eatec had lots of experience and knowledge of over the years. As a result, by checking the pilot results for consistency, they felt that they were able to verify the results to some extent based upon their own experience and intuition.

4.3.1.1 Analysing the JAS results

The pilot results are shown in table 4.5. The rating provided by Director EF was higher than those given by the other Directors. This was because Director EF had used the ‘direct data entry’ option instead of the ‘comparative data entry’ option which was what the other two Directors had used for the scoring. JAS allows the user to run two different types of exercises: comparative and direct entry. The researcher noted a feedback from the Directors that this added to the confusion for the user. Whilst these types of testing within the JAS (comparative and direct entry) may have been developed for different evaluation purposes, the software was not particularly user friendly in Eatec’s context.

The importance of defined attributes for Finite Element Analysis (FEA) service									
FEA	size of segment	growth of segment	competition	prior experience	no of medium size companies	consultancy or contract	cost conscious	relevant expertise	inten of compet
Director AB	5.9	11.8	8.9	29.6	4.7	4.7	2.4	29.6	2.4
Director CD	1.8	1.8	8.8	17.5	17.5	17.5	8.8	17.5	8.8
Director EF	1.6	4.8	9.5	17.5	15.9	11.1	9.5	19.0	11.0
Average score for all	3.1	6.1	9.1	21.5	12.7	11.1	6.9	22.0	7.4
The importance of defined attributes against defined market sectors									
	Aerospace	Automotive	Consumer goods	Defence	Medical	Oil & Gas	Processing (food & paper)	Rail	
Director AB	14.5	13.4	9.6	11.1	11.0	16.8	9.3	14.2	62.4
Director CD	5.5	9.3	11.6	16.3	13.4	15.0	14.3	14.5	73.5
Director EF	60.2	62.3	48.7	59.4	60.3	76.7	72.2	72.0	340.6
Average score for all	26.7	28.3	23.3	28.9	28.2	36.2	31.9	33.6	
The importance of defined attributes for Testing service									
Testing	size of segment	growth of segment	competition	prior experience	no of medium size companies	consultancy or contract	cost conscious	relevant expertise	inten of compet
Director AB	6.2	7.5	3.7	31.1	3.7	8.1	5.6	31.1	3.1
Director CD	2.1	2.1	10.6	10.6	21.3	21.3	10.6	10.6	10.6
Director EF	1.9	1.9	3.9	15.5	19.4	13.6	13.6	15.5	14.6
Average score for all	3.4	3.8	6.1	19.1	14.8	14.3	9.9	19.1	9.4
The importance of defined attributes against defined market sectors									
	Aerospace	Automotive	Consumer goods	Defence	Medical	Oil & Gas	Processing (food & paper)	Rail	
Director AB	9.7	9.2	13.2	9.7	13.7	20.5	13.1	10.9	67.9
Director CD	4.9	6.4	13.5	14.6	12.9	17.6	18.0	12.2	75.3
Director EF	25.1	37.8	22.4	54.4	62.5	75.2	63.4	65.7	321.2
Average score for all	13.2	17.8	16.4	26.2	29.7	37.8	31.5	29.6	
The importance of defined attributes for Monitoring of Transportation service									
Monitoring of Transportation	size of segment	growth of segment	competition	prior experience	no of medium size companies	consultancy or contract	cost conscious	relevant expertise	inten of compet
Director AB	7.0	21.0	6.3	14.0	7.0	14.0	10.5	14.0	6.3
Director CD	10.0	2.0	10.0	4.0	12.0	20.0	12.0	20.0	10.0
Director EF	1.8	3.7	1.9	18.5	9.3	18.5	13.0	18.5	14.8
Average score for all	6.3	8.9	6.1	12.2	9.4	17.5	11.8	17.5	10.4
The importance of defined attributes against defined market sectors									
	Aerospace	Automotive	Consumer goods	Defence	Medical	Oil & Gas	Processing (food & paper)	Rail	
Director AB	7.1	11.8	20.7	7.1	18.8	9.5	14.6	10.5	60.5
Director CD	11.0	12.1	18.6	13.2	12.0	13.7	7.7	11.7	58.3
Director EF	5.2	5.9	18.3	12.8	19.7	13.0	14.6	10.4	70.5
Average score for all	7.8	9.9	19.2	11.0	16.8	12.1	12.3	10.9	

Table 4.5. JAS pilot results

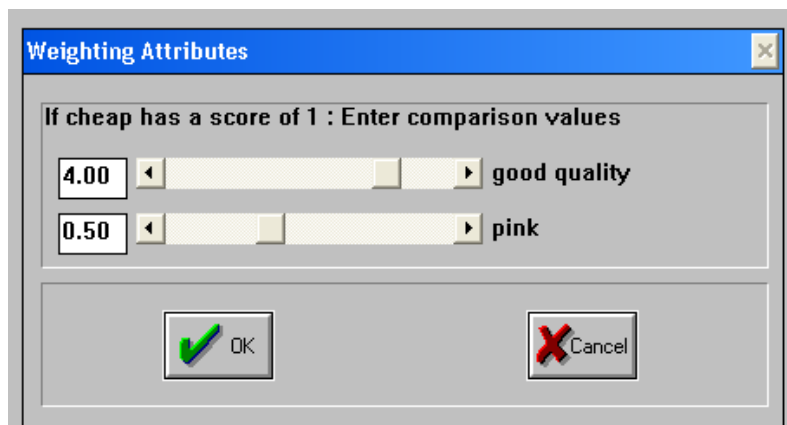
The JAS system was designed to enable users to evaluate various attributes and decision alternatives in an extremely structured way. To explain the JAS concept simply, the researcher illustrates a simple example below which was initially used to propose and convince the Directors in adopting this system for the segmentation evaluation and selection process.

4.3.1.2 Explaining the structure of JAS

A user needs to make a decision to purchase a soft toy. The choices are a cat, a dog or a mouse. Attributes for choosing the toy needs to be cheap, good quality and pink. Once these are inputted into the system, the user needs to weight the attributes. There is only one test for weighting the attributes which is a comparison test; the user compares the importance of each attribute against each other. The weighting of each attribute against each other is explained below.

Weighting Attributes

A comparison test is comparing the score for one item with the score of another. For example, the image below shows that if the attribute for it being cheap was scored at 1, then the user needs to compare the importance of it being good quality against it being cheap. In the example shown below, if cheap scores 1 then good quality scores higher at 4. This means good quality is 4 times more important than it being cheap. On the other hand, the attribute that it has to be pink in comparison to it being cheap is not that important. Therefore, the user has rated it less than 1 at 0.50 (i.e. half as important). The user repeats this exercise 2 more times for the attributes good quality and pink as illustrated below.



Weighting Attributes

If cheap has a score of 1 : Enter comparison values

4.00 good quality

0.50 pink

OK Cancel

Weighting Attributes

If good quality has a score of 1 : Enter comparison values

2.13 ◀ ▶ cheap

0.68 ◀ ▶ pink

☒ OK ☐ Cancel

Weighting Attributes

If pink has a score of 1 : Enter comparison values

2.13 ◀ ▶ cheap

0.34 ◀ ▶ good quality

☒ OK ☐ Cancel

Assess your choices

The next step is for the user to evaluate the three choices of cat, dog or mouse. At this stage, the user has a choice to do two tests as mentioned earlier.

The comparative test is where the user compares the score for one item with the score of another as explained earlier. For example, as illustrated below, the user is assessing the choices going by the fact that it has to be cheap. So if cat has a score of 1 and the user feels that the dog costs more, then the user rates dog less than 1. On the hand, the user feels that a mouse is more expensive than the cat, so it is rated higher than a 1. This scoring is repeated for dog and mouse under the attribute 'cheap'. The process is repeated 2 more times for attributes 'good quality' and 'pink'.

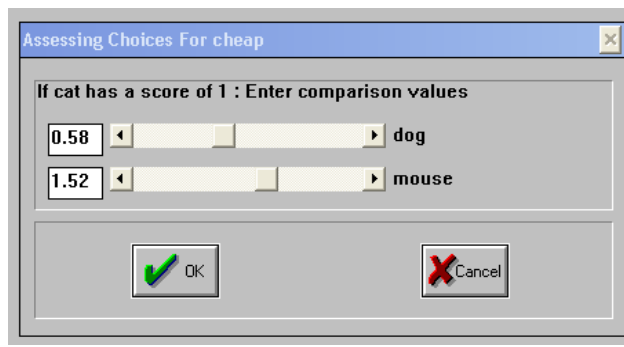
Assessment Selection

Select Exercise Type

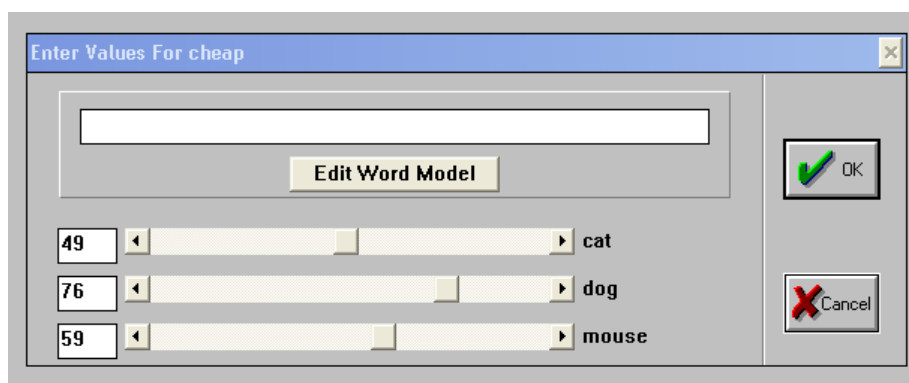
- ☒ Comparative
- ☐ Direct Entry

- ☒ Weight Attributes
- ☒ Assess choices for cheap
- ☒ Assess choices for good quality
- ☒ Assess choices for pink

Display Results



With a direct entry test, the user enters a direct score for each choice. There is no comparison between each of the choices. For example, the image below illustrates an assessment for the toy being cheap. With a score range of 0 to 100, the user rates each choice with a direct score. For example, the image below illustrates that the dog is cheaper so the user rated it high at 76. The mouse is second cheapest and so receives a score of 59, with cat being most expensive and so scores 49. This test is repeated 2 more times for attributes 'good quality' and 'pink'.



Although the direct entry test appears to be less tedious than the comparison test, the comparison test is much more rigorous and tests for consistency in the users rating between the various steps for each choice (cat, dog and mouse). Therefore, the comparison test should be more favourable.

With either of the above tests completed, the software can calculate the overall favourable choice taking into consideration the weightings for the attributes provided by the user at the beginning of the JAS test.

The Directors were convinced with this structured system and persevered with the pilot test even though they had found the system not particularly easy to use.

Table 4.6 highlights the average scores for the highest ranked market sectors for each of the services provided by Eatec.

Rank	Finite Element Analysis		Testing		Monitoring of Transportation	
1	Oil & Gas	36.2	Oil & Gas	37.8	Consumer Goods	19.2
2	Rail	33.6	Processing (food & paper)	31.5	Medical engineering	16.8
3	Processing (food & paper)	31.9	Medical engineering	29.7	Processing (food & paper)	12.3
4	Defence	28.9	Rail	29.6	Oil & Gas	12.1

Table 4.6. JAS results for 3 services - average scores for the highest ranked markets

The scores for all three services were then summed and averaged for each market sector and listed in rank order (table 4.7).

Rank	Market Sectors	Average score
1	Oil & Gas	86.0
2	Processing (food & paper)	75.7
3	Medical engineering	74.8
4	Rail	74.0
5	Defence	66.2
6	Consumer Goods	58.9
7	Automotive	56.1
8	Aerospace	47.4

Table 4.7. JAS results for all services summed to give rank of market sectors

The results came as a surprise to the Directors as they initially had made assumptions which the results did not match. Several years of practice in engineering consultancy meant that the Directors felt that they had sufficient experience to recognise instinctively the likely outcome, or had a ‘gut feel,’ of what the most attractive market sectors would be. The Directors felt that perhaps the weightings were not representative, or that the weightings were distorted with some of the analysis carried out using direct entry (by Director EF) instead of everyone being consistent using the comparison test.

4.3.1.3 Appropriateness of JAS technique for Eatec's context

First, the Directors felt that the attributes shown in table 4.4, while indeed relevant to each sector, in fact varied in importance for each of the seven service sectors in which they operated. An attribute that was important to one service sector was not necessarily perceived to be an important attribute to another service sector in a market sector. Therefore, the Directors felt uncomfortable putting a weighting on each attribute knowing that the JAS calculations for each market sector would be calculated against an inaccurate attribute weighting.

Secondly, the pilot testing took considerable time to complete. Therefore, a full analysis would be too costly if it were to be repeated several times using JAS. The researcher concludes from the action learning that when many decision alternatives are involved, such as in Eatec's case with eight market sectors scoring against eight services, the decision making process becomes too complex and too long-winded.

The researcher recognises the benefits of a structured system like JAS because decision making was guided by three clearly defined steps: deciding the attributes upon which a decision is to be based, allocating weights to the different attributes, and then scoring each alternative on the attributes. It has been used in a number of different business-to-business contexts successfully (e.g. Islei et al., 1991, 1999; Lockett and Naudé, 1996; Naudé et al., 1997), but a small company like Eatec requires a far less structured and complex judgemental system to assist in the evaluation and selection process of segmentation, but at the same time to allow the user to use intuition as part of the scoring and decision making process.

4.3.2 Revised judgemental modeling approach to segmentation

Given the Directors' reticence to JAS due its overly complex and structured approach, and yet cognisant of the need to formalise the process, a modified approach was developed. The researcher revisited the knowledge captured during the literature review to develop a revised judgemental model. As well as Lockett and Naudé's (1996) MCDM approach using JAS, the researcher also highlighted the advantages of Palmer and Millier's (2004) matrix form of data capturing that could potentially be adapted to Eatec's context. An adoption of this approach meant that each Director was faced with an 8x8 matrix (table 4.8): a choice of eight industry sectors (as defined in section 4.2.5) on the vertical scale, and eight service offerings on the horizontal (these were made up of the original six defined in chapter 1, table 1.1 plus monitoring of transportation (as explained in section 4.2.5), plus an additional "overall company" category, meaning all services put together as one company offering.

In this new approach, each Director was asked to take into account all the market knowledge gained from the earlier market research reports, as well as own experience and intuition (Lockett and Naudé, 1996; Palmer and Millier, 2004) and then make a judgement by rating each of the eight market sectors on a scale of 1-5, with a score of 5 indicating that conditions are very favourable for investing in that sector.

Market	Service	1	2	3	4	5	6	7	8
	Rank on scale of 1-5 (5 = favourable conditions for investment)	Overall company (all services)	FEA	Structural Integrity	CFD	Testing	Mathematical Modelling & Simulation	Data handling	Monitoring of Transportation
1	Aerospace								
2	Automotive								
3	Consumer Goods								
4	Defence								
5	Medical Engineering								
6	Oil & Gas								
7	Processing (food & paper)								
8	Rail								

Table 4.8: 8x8 matrix for revised judgemental modeling approach

The attributes agreed during the JAS process were reused in this revised approach which formed part of the factor for assessing a market's attractiveness in the multi-criteria decision making process. By adopting elements from Lockett and Naudé (1996) and Palmer and Millier's (2004) model, a modified process evolved which enabled the Directors to independently judge in confidence each market sector with Eatec's skills and services.

The Directors utilised their own intuition in this modified process when regarding customer needs; needs which vary from sector to sector. In this modified process, decision makers are able to come to a decision with a score which ranged from 1 to 5 (5 being most favourable) that entailed personal industry knowledge and experience (where applicable), with hard facts from marketing intelligence on what the sector demands. This process makes a complex decision making task much easier to manage. It also enables multiple decision makers to carry out segmentation evaluation using the multi-criteria decision making approach. By summing up all scores, a consensus agreement was achieved.

The following table shows the Directors ratings summed up and placed in order of highest points. Max score is 15.

Rate	Services							
	Overall Company	FEA	Structural Integrity	CFD	Testing	MM* & Simulation	Data Handling	Monitoring Transportation
1st	Oil & Gas (15)	Processing (13)	Processing (13) Oil & Gas (13)	Processing (13)	Processing (15)	Oil & Gas (15)	Oil & Gas (15)	Consumer (15)
2nd	Processing (12)	Rail (12)	Rail (12)	Oil & Gas (11)	Defence (10)	Defence (10) Processing (10)	Defence (10) Processing (10)	Medical (11)
3rd	Rail (10)	Defence (11) Oil & Gas (11)	Defence (7) Automotive (7) Aerospace (7)	Medical (8)	Oil & Gas (9)	Medical (7)	Rail (8) Automotive (8)	Defence (9)
4th	Defence (9)	Automotive (7) Medical (7)	Medical (6)	Automotive (6)	Rail (7) Medical (7)	Aerospace (6)	Aerospace (7)	Rail (8) Oil & Gas (8)
5th	Automotive (7) Medical (7)	Aerospace (6)	Consumer (3)	Defence (5) Rail (5)	Consumer (6)	Rail (5) Automotive (5)	Consumer (6) Medical (6)	Processing (7)
6th	Aerospace (5)	Consumer (4)		Aerospace (4)	Automotive (5) Aerospace (5)	Consumer (4)		Automotive (6)
7th	Consumer (4)			Consumer (3)				Aerospace (5)

Table 4.9. The sum of all three Directors' scores of the 8x8 matrix analysis

Table 4.9 shows the tabulated results of the Directors' evaluation of the market sectors against the services. These are ranked to provide the top four market sectors. For example, it was apparent that when the Directors were considering Finite Element Analysis (FEA), the combined score was 13 out of a possible 15, placing the processing market sector in the top position, ahead of rail in second position.

Overall, there was clearly a strong preference for sectors Oil and Gas and Processing: while Processing was ranked top in four of the seven service areas, Oil and Gas was ranked top in three of them but was also regarded as being the top "overall" sector (in which it scored the maximum of 15 points).

Market Sectors	Total Score	Score excluding Overall Company
Oil & Gas	97	82
Processing	93	81
Defence	71	62
Rail	67	57
Medical Engineering	59	52
Automotive	51	44
Consumer Goods	45	41
Aerospace	45	40

Table 4.10. Total scores per sector through revised judgemental modeling approach

In table 4.9, the total scores are shown for each market sector by summing across each service. In order of the highest rank score, the top four market sectors are Oil and Gas, Processing, Defence and Rail.

However, there was an element of double counting and/or of the "halo effect" here, in that if a particular sector scores well across the various services, it was also likely to score well in the "Overall Company" column, and yet this column was used to calculate the total scores shown in table 4.10. For this reason, the final column ("Score Excluding Overall Company") showed the scores of the various sectors, but excluded the overall company score. It was evident again that sectors Oil and Gas and Processing were regarded as having the best potential, followed by Rail and Defence.

A meeting to discuss the results was held. The researcher noted that the Directors were more at ease with the outcomes gained from the revised judgemental modeling approach than from the outcomes gained from the JAS model. The Directors were not intuitively at ease with the resultant answers gained from JAS because they "did not conform to our gut feel."

The JAS results for the top four sectors were Oil and Gas, Processing (Food and Paper), Medical engineering and Rail. However, the resultant answers with the subsequent approach was also (in different order) processing (Food and Paper), Oil and Gas and Rail, but instead of Medical engineering, the subsequent approach showed Defence as a top ranking sector.

The results from the subsequent approach (an evolved approach where the Directors were comfortable with) were almost the same as the outcome from the JAS approach (3 out of 4 sectors were the same as those selected using the JAS approach). This is a valuable insight as the researcher has discovered through this action learning that the Directors may not necessarily be at unease with the JAS approach, but rather at unease with the complex structure and decision making process of JAS and this therefore raised the Directors' doubts with the resultant answers.

Subsequent to the evaluation and selection of target market sectors, the researcher had to ensure that appropriate marketing plans were in place to pursue the company's business objectives (as defined in table 4.1). To do this, the Directors agreed that target clients within the selected target market sectors (Processing, Oil and Gas, Rail) need to be evaluated and selected so that appropriate marketing communication campaigns can be implemented. After discussions with the Directors on evaluation and selection criteria, it was agreed that potential clients can be segmented simply by the size of the company, their geographic location, establishing key decision makers and preferably operated in the target market sectors selected.

The researcher revisits the knowledge captured in the literature review and contends that this is clearly a Bonoma and Shapiro (1984) macro segmentation approach which initially focuses on determining the characteristics of the client through organisation size and structures, geographical locations right down to the details of decision making units. The next section explains briefly the subsequent segmentation approach following the evaluation and selection of favourable market sectors.

4.3.3 Evaluating and selecting target clients

Potential target companies were selected by using a readily available database called Kompass¹, purchased especially for this segmentation purpose. The criteria used to retrieve company details from the database were by size of the company (250 and above) and geographic location.

By selecting different regions starting from those with the closest proximity to Eatec and then expanding the search outwards (see figure 4.3, a map which assisted the Directors in selecting the target companies), the researcher was then able to draw up 11 lists of companies from different geographical regions (see table 4.11, selected companies sort by region).

Table 4.11 shows the regional groups retrieved from the Kompass database. The result column shows two figures; before and after. The 'before' figure indicates the number of companies retrieved from the database which met the agreed criteria (over 250 people and within the set geographic location). The list of companies was then evaluated using a further set of agreed criteria to filter the target companies.

The subsequent criteria used for the selection were contact names, job titles and preferably operating within the selected market sectors. These variables typically identifies whether the person is a decision maker within an engineering function at a managerial level. However, these variables could only be obtained by calling each company that was filtered from the Kompass database, as the database itself could not provide data to this depth of detail.

¹ Kompass is an online business resource that provides a database of industrial and commercial companies. It can be searched using a wide variety of criteria that can be used to refine a search and identify specific companies.



Figure 4.3. Regional map used for subsequent segmentation

Group	County	Result
Group 1	Gloucestershire	Before: 328
	Mid Glam	After: 145
	Oxfordshire	
	Somerset	
	West Glam	
	Wiltshire	
	Avon	
	South Glam	
Group 2	Berkshire	Before: 437
	Hampshire	After: 172
	Dorset	
	Surrey	
Group 3	Devon	Before: 357
	Bucks	After: 162
	Powys	
	Dyfed	
	Gwent	
	Hereford	
	Warwick	
	Worcestershire	
	Herts	
Group 4	West Midlands	Before: 361
	Staffordshire	After: 197
Group 5	Bedfordshire	Before: 346
	Shropshire	After: 134
	Cornwall	
	Leicestershire	
	Cheshire	
	Clywd	
Group 6	London	Before: 597
		After: 33
Group 7	Derbyshire	Before: 351
	Middlesex	After: 100
	Nottinghamshire	
Group 8	W. Sussex	
	Channel Islands	Before: 401
	Gwynedd	After: 178
	East Sussex	
	Kent	
	Essex	
	Cambridgeshire	
Group 9	Northamptonshire	
	Suffolk	
	Norfolk	Before: 322
	Lincolnshire	After: 147
	Lancashire	

Group	County	Result
Group 10	S. Yorkshire	Before: 431
	N. Yorkshire	
	County Durham	
	Northumberland	
	Dumfriesshire	
	Roxburghshire	
	East Lothian	
	West Lothian	
	Midlothian	
	Lanarkshire	
	Ayrshire	
	Fife	
	Angus	
	Banffshire	
	Benwickshire	
	Clackmannanshire	
	Dunbartonshire	
	Aberdeenshire	
Group 11	Cleveland	
	County Antrim	Before: 434
	County Armagh	
	County Down	
	County Londonderry	
	County Tyrone	
	Cumbria	
	Inverness-Shire	
	Isle of Man	
	Isle of Wight	
	Merseyside	
	Morayshire	
	North Humberside	
	Peeblesshire	
	Perthshire	
	Renfrewshire	
	Ross-Shire	
	Sekikshire	
	South Humberside	
	Stirlingshire	
	Tyne & Wear	

Table 4.11. Selected number of companies sort by region

The segmentation process of filtering the initial company lists was carried out by Eatec's secretary. This process was demanding and difficult because the secretary had to phone up a total of 4365 companies (sum of all 11 groups, table 4.11) to obtain the following:

- 1) an appropriate contact name to whom Eatec can send marketing information to, and that person needs to be the main decision maker in outsourcing engineering work
- 2) job title to determine seniority within firm
- 3) preferable operating within the selected market sectors (sometimes this can be difficult to define as the researcher found that many companies do not specialise in a particular sector but work cross sector)

Barriers to this process included:

- Companies who were unwilling to provide contact names
- Busy switchboards
- Switchboards who diverted calls straight through to the decision maker

In particular with the last point, an immediate phone transfer to the decision maker was intimidating to the secretary. The researcher discussed the issues with the secretary and found that as a non-engineer, she was not confident to answer technical questions and quite often, decision makers would query Eatec's services and purpose of the call. The researcher learns that this filtering task is ideally best carried out by a business development manager with some engineering knowledge because the cold call could be perceived as a chance to introduce Eatec's services to the decision maker and thus attempt to engage in a business development conversation.

The researcher learns that potential barriers, as described above, need to be addressed immediately. This is where an external facilitator is valuable and can focus on addressing such problems. If collecting such segmentation characteristics is not successful and becomes a hindrance to the whole segmentation process, then the former segmentation scheme of evaluating and selecting target market sectors becomes a pointless task because subsequent schemes cannot be developed from it.

As a result of this subsequent segmentation approach, the number of target companies as illustrated by the 'after' figure in the results column of table 4.11 decreased by 50% making it a manageable target client list. Segmentation of groups 1 to 9 was completed during the

researcher's two year contract. Groups 10 and 11 were yet to be done at the time when the researcher was still working at the company.

4.3.4 Lessons learnt from stage 2 'during segmentation' phase

The field of judgemental modeling and MCDM is a well-known one, with numerous well-cited examples of successful implementation of the underlying decision making structures (see Islei et al., 1991, 1999; Naudé et al., 1997, for example). And yet in this case study, the application of judgemental modeling demonstratively failed, with the Directors involved seeking an alternative approach – why, and what does this potentially tell us about adopting structured approaches to the market segmentation process?

There was no doubt that using an approach based upon MCDM in the segmentation evaluation and selection process assisted the Directors to structure their decision making. It was felt however, that the disadvantages of using JAS overshadowed the advantages in their segmentation exercise. This was due to a number of reasons.

First, the decision matrix (figure 4.2) was too complex, with too many variables and levels of variables being required in the analysis. A corollary of this was that a relatively large number of weightings had to be assigned, and the successive use of the pair-wise comparisons required by the software resulted in user fatigue. In spite of the decision makers involved having undertaken the prior pilot test of the software – or quite possibly because of the pilot test undertaken, it was decided that “we were using a sledgehammer to crack a nut.”

A second set of factors surrounded the scoring process, namely the difficulty involved in defining the relationship between an industry and the associated attribute with a single number. While the subsequent approach also required the use of a number, it was felt that this 1-5 scoring process was somewhat easier and intuitively more appealing. Essentially what this revised process did was to remove the structure surrounding level 2 in figure 4.2, and instead the Directors were required to make the link between levels 1 and 3 directly with a single 1-5 number that intuitively included all the aspects previously identified as being relevant in level 2.

The third set of factors that hindered the process emerged as a result of having undertaken the JAS pilot test, and of not being intuitively at ease with the resultant answers because they “did not conform to our gut feel” as explained in section 4.3.2.

Structured systems are important to pull marketing intelligence, analysis and experience together in one process (Brooksbank, 1999) but what this case study suggested was that structured approaches cannot be applied to the decision making and evaluation process within market segmentation. The strategic decision making processes in large organisations are depicted as a series of "steps" or "phases" as well as contextual factor influences (Jocumsen, 2004).

Small businesses follow a much less complex process in making their strategic marketing decisions as illustrated in this research. The researcher learned that whilst Eatec benefited with some form of structure in place to manage the segmentation process, the actual evaluation and selection process cannot be too structured or complex. It needs to be flexible enough to incorporate intuition and reliance on past decision experience within the judgemental analysis. The researcher examines the findings and action learning in detail in the next chapter.

Following the segmentation process, the researcher continued to facilitate in the implementation of a strategic marketing plan for Eatec. To discuss the full segmentation programme from start, during to the implementation and effectiveness of subsequent marketing strategies would provide a holistic view for the reader. Although useful to managers to understand segmentation within the broader rubric of a strategic marketing plan, it is somewhat misplaced in the context of this thesis where the focus is to understand the issues involved in b2b segmentation, more specifically how equally favourable market sectors can be evaluated and selected. Subsequent reports on actions following the segmentation process are therefore included in appendix 3 instead. Although these reports do not fit into the existing research objective, the implementation study did instigate further investigation queries on how the measure of effectiveness as a result of the segmentation strategy or effectiveness as a result of subsequent marketing campaigns can be monitored.

Chapter 5

Research findings and learning points

The segmentation problems encountered in the research and the alternative evaluation and selection process developed will be discussed in greater detail in this chapter. Learning points are highlighted throughout this chapter.

5.1 Understanding the 'Before segmentation' stage

Before the actual segmentation process, the researcher found that it was necessary to establish specific knowledge to facilitate the Directors' decision making process. These were:

- Establishing company objectives
- PEST analysis
- SWOT analysis
- Establishing business objectives
- Carrying out market sector research

5.1.1 Learning point: facilitator intervention

The researcher agrees with Palmer and Millier (2004) that managing the segmentation process was both demanding and difficult. The researcher had a dominant role in facilitating the process, in particular when Directors had wanted staff to participate in certain discussion areas. The only feasible way to carry out such a session was to have regular group meetings for brainstorming with defined agendas where the researcher facilitated at all stages. As a participant observing the discussions, the researcher noted areas of disparity during some brainstorming sessions. For one particular discussion on defining corporate objectives, discussions had diverted to non-segmentation issues such as investment in staff training and software development.

It was unforeseeable that meetings and processes concerning segmentation could ultimately impact on personnel issues since the researcher did not find anything in the literature review that indicated this, but in this case study it did. The contention that segmentation is integrated within the greater context of business management and strategic marketing issues is not new. The researcher learnt from this research that initiating segmentation results in a potential rippling effect that can impact on issues and areas, which may not appear at first to

be linked with the task at hand. Such issues however cannot be ignored. Palmer and Millier (2004) had indicated that even when managers achieve an appropriate segmentation process, their reliance on colleagues to implement the actions arising remains. Thus, the researcher feels that the opinions and concerns need to be respected in this process.

The Directors remained sceptical to how the knowledge transfer partnership could benefit Eatec. The advantage of having the researcher as a facilitator was obvious at this stage. Dibb (1988) wrote that some businesses make the mistake by viewing segmentation as a tactical trick rather than a process viewed on a longer term perspective. As with Eatec, the Directors' scepticism could have hindered the process and interests would have gradually been diverted to more important business issues. However in this case, because a facilitator had maintained that focus and ensured that the process was held together.

Dibb and Simkin (1997) stressed that a long-winded process should be avoided but in Eatec's case, it had taken longer than expected (from January to July 2002). However, the researcher has learnt that the six months leading in time before initiating a segmentation process was valuable as it gave the researcher a chance to settle into the company as well as for staff to get use to a new face. A number of exploratory market research was carried out by the researcher which took approximately six months, but it was a necessary task. The absence of a facilitator would have meant that the process would have taken much longer if not potentially stalled due to fading enthusiasm.

In agreement with the findings of Palmer and Millier (2004), this case highlighted that the intervention of a facilitator acted as a bridge between academic schemes of segmentation and the day-to-day reality of the research. Responding to academic schemes of segmentation and what could be realistically managed on a day-to-day basis is discussed in the next section.

5.2 Understanding the 'Segmentation process'

The research objective was to develop an understanding on how equally favourable market sectors can be evaluated and selected.

Initially, the agreed approach was to use the MCDM method through the use of JAS (Lockett and Naudé, 1996) to evaluate and select target market sectors and that it would take no more than two months (July to August 2002). With numerous well-cited examples of successful implementations there was no reason to believe why it would fail in this context. So what happened?

The researcher did not feel that the MCDM approach using JAS failed because the actual results did not suggest so. The results are summarised below. The numbers in the brackets represent the scores relevant to the methods that were adopted. The 8x8 matrix scores exclude the 'overall company' offering option because JAS did not consider overall company within part of the decision matrix.

JAS selected markets:

- 1) Oil and Gas (86)
- 2) Processing (food & paper) (75.7)
- 3) Medical Engineering (74.8)
- 4) Rail (74)

8x8 matrix selected markets:

- 1) Oil and Gas (82)
- 2) Processing (food & paper) (81)
- 3) Defence (62)
- 4) Rail (57)

The researcher felt that it was the methodology that had failed because it did not receive the confidence of the users. The Directors were not intuitively at ease with the resultant answers because the Directors expressed that "it did not conform to our gut feel." The selected target market sectors under both methods were almost the same (differed on medical engineering for JAS, and defence for the 8x8 matrix approach). This suggests that the Directors were uneasy with the complex structure and decision making process of JAS. If a user is not comfortable with the process, then it is likely the user would doubt the results. This would be the plausible explanation because the alternative evaluation and selection approach gave similar results but the Directors were seemingly more satisfied with the results of the subsequent approach. Although not the user, the researcher had observed the lengthy process of the former Judgmental modeling approach and would also have been 'put off' by the mammoth evaluation task at hand. Personally, the researcher sympathises with the Directors and contends that the alternative approach was less structured and thus intuitively more appealing.

5.2.1 Learning point: A method cannot be too structured in the evaluation process

The Directors were not opposed to the MCDM approach (Lockett and Naudé, 1996) and so this element of decision making was kept in the alternative evaluation and selection approach. We know that in the evaluation process the Directors needed to consider:

- 1) Hard data from the market sector reports
- 2) Multi-criteria decision making (attributes of each market sector and services involved)
- 3) Intuition

The researcher attempts to understand what made the alternative approach successful by looking at the ‘thinking’ behind the judgmental analysis process.

The thinking stage is when the Directors were evaluating the target markets using the MCDM approach (Lockett and Naudé, 1989) with an 8x8 matrix as a tool to capture the evaluation scores (method adapted from Palmer and Millier, 2004). In the thinking process of evaluating the market sectors, the Directors were able to come to a decision with a score which ranged from 1 to 5 (5 being most favourable) based on their own personal industry knowledge and experience (where applicable), with knowledge gained from the market research reports. The Directors had considered to the best of their knowledge the demands of the market. At the same time, the Directors had considered in their decision making process, how accessible it was for Eatec to sell to that market based on their own in-house capabilities, company location, the service the Directors wanted to push forward and the resource available. The researcher recognises that this thinking process within a business-to-business context is not dissimilar to the well developed and tested model of buyer behaviour known as the stimulus-response model (Kotler, 1992).

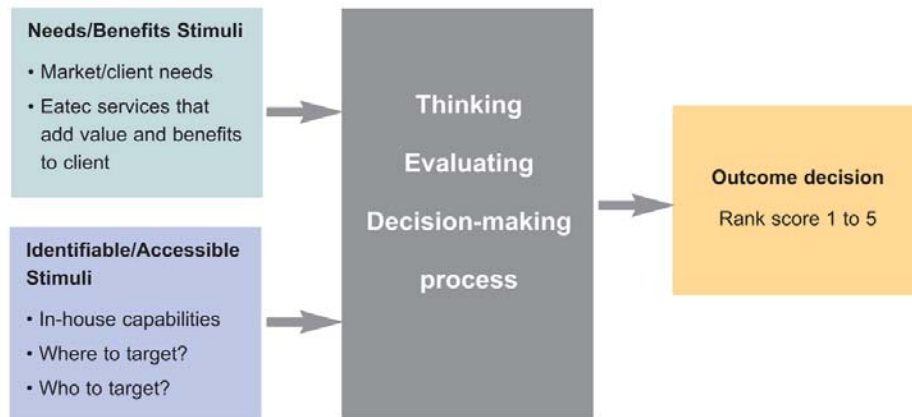


Figure 5.1. Stimulus-Outcome model of segmentation decision making process
(source: adapted from Kotler, 1992)

Kotler's (1992) viewpoint was that marketing and other stimuli enters the customers 'black box' and produces certain responses and marketing managers must try to work out what goes on in the mind of the customer – the black box. Although this is predominantly a business-to-consumer model, the theory can be applied to this case study to illustrate the Directors' decision making process in business-to-business segmentation.

The researcher has adapted the stimulus-response model (Kotler, 1992) and illustrated that the 'black box' (figure 5.1, grey box in the centre of the diagram) was influenced by inputs based on stimuli that can predominantly be categorised into needs/benefits and identifiable/accessible, factors initially introduced by Bonoma and Shapiro (1984). The input, having been mediated by the black box (such as experience, knowledge, intuition/gut-feel which affects the thinking, evaluating and decision-making) thus leads to attitudinal change. Ultimately, the outcome to actions was in the form of a decision with a score which ranged from 1 to 5 (5 being most favourable).

Whilst Palmer and Millier (2004) offered a fairly generic approach to the segmentation task based upon the idea of utilising managerial intuition, the researcher has illustrated the use of intuition in action within the 'thinking process' or in the 'black box'. The question of what actually occurs within the 'black box' remains. However, the researcher has attempted to develop an understanding of the complexity that goes on in the decision making process within the context of business-to-business segmentation. When a decision maker is faced with a strong desire to rely on intuition, they are also at risk of being criticised for the lack of

a measured approach by managerial demands. Thus, decision makers are faced with the need to be rational about business decisions regardless of their intuition or experience.

In this respect, JAS was too structured for this complex level of decision making because too many alternative market sectors and services were involved. This added to the potential lengthiness of the task and thus resulted in user fatigue. Adopting structured approaches to the overall market segmentation process is advisable by many academics (Dibb and Simkin, 1997; Brooksbank, 1999; Goller et al., 2002), but the researcher highlights that the actual *decision making and evaluation* process needs to be flexible enough to accommodate the complex thinking behind the judgmental analysis and evaluation. The alternative evaluation and selection approach developed was the appropriate compromise for this case study.

5.2.2 Learning point: There are two ways to select market sectors

After analysing the 8x8 matrix and the results from the selection process, the researcher learns that there are actually two possible ways in which the target markets could have been selected.

The first way was of course the one described in the research where the scores of all services were tabulated for each market sector and then ranked by order of total scores. This is the most convenient method because it is simply based in a utility points system, the more points the better. However, this approach does not take into consideration the needs and benefits of each sector. For example, Defence and Rail was rated at 5th position for CFD services.

If Bonoma and Shapiro's (1984) 'needs/benefits segmentation approach' was adopted instead as an alternative selection method, then Defence and Rail market sectors would not have been chosen. This is because under CFD services these two sectors did not gain very many 'utility points'. To put this into context, the Directors may have evaluated that whilst they had the capability, through the MCDM approach, CFD may have looked unfavourable in these market sectors due to factors such as competitiveness within the existing market. Hence, evaluating the scores column by column by services enables the user to identify bespoke requirements of each market sector.

Thus, selecting market sectors through a ‘needs/benefits segmentation approach’ would have resulted in the following segmentation strategies instead:

- Target the **Processing (Food and Paper)** sector with FEA, structural integrity, CFD, testing, mathematical modeling and simulation and data handling
- Target the **Oil and Gas** sector with FEA, structural integrity, CFD, mathematical modeling and simulation and data handling
- Target the **Defence** sector with FEA, testing, mathematical modeling and simulation and data handling
- Target the **Rail** sector with FEA and structural integrity
- Target the **Consumer** sector with monitoring of transportation
- Target the **Medical engineering** sector with monitoring of transportation

Whilst this segmentation approach does target specifically the needs of each market sector, it is potentially very complex to manage. Due to Eatec’s lack of resource, this would not have been a feasible approach at this stage. It was therefore much easier to adopt the convenient segmentation selection approach as used within the research, by tabulating and ranking total scores.

Following the evaluation and selection of market sectors, a subsequent segmentation approach to selecting target clients was required. The segmentation was largely based on using traditional variables such as size of the company and geographic locations. However, the lists retrieved from Kompas database were not immediately usable and had to be filtered by mapping the appropriate contact names and decision makers with an interest of work within the selected market sectors. This level of detail could only have been retrieved by calling each segmented client list. It was here that the subsequent segmentation scheme faltered.

5.2.3 Learning point:

Barriers to segmentation (commitment, enthusiasm and cooperation)

Potentially, this was a cold calling exercise, but it was an essential segmentation phase to identify the appropriate target clients within the selected market sectors. A practitioner should use this stage to develop sophisticated client portfolios. However, the barrier in this case study was in initiating the right person to do the job.

The researcher identified two potential staff: the company's administration coordinator and a business development manager with engineering background. Unfortunately, the business manager's reluctance to do this exercise, in view of it being only a simple cold calling administration exercise, meant that the administrator had to carry out the task instead. The researcher did observe difficulties on the administrator's part during this exercise. Mainly it was her lack of engineering knowledge to respond to questions which impacted on her confidence. After a few attempts, it was agreed that she would respond by saying that an engineer would call back; often this was a missed opportunity on the company's part to establish credible business calls and thus establish potential contacts. Moreover, a business development manager with engineering knowledge is best placed to segment between favourable and non-favourable target clients. The literature review had highlighted that a number of problems existed in putting segmentation theory in practice (Palmer and Millier, 2004). These included lack of guidance to make segmentation work and how to evaluate market/client attractiveness. This case study highlighted that it was the lack of staff commitment and enthusiasm that became the barrier to successful implementation. The researcher did not feel comfortable addressing this hindrance to the Directors as it impacted on personnel issues. With hindsight, the importance of this stage was overlooked by the researcher acting as a facilitator.

What the researcher has learnt in this case study is that successful segmentation does not end with having successfully evaluated and selected market sectors. Whilst understanding the evaluation and selection process of market sectors was the core focus of this research, future recommendations would be to 'better market the equal importance of this subsequent segmentation stage in selecting target clients within the company', even if it appears to be a mundane administrative task. It would be interesting to further investigate if there is an easier way to segment target clients.

5.3 Researcher influence and learning

The researcher supported the views of Richardson (1995), Dibb and Simkin (1997) and Palmer and Millier (2004) regarding the involvement of a facilitator or occupying someone external to the process, such as the researcher in this case. From the researcher's experience in this study, it could be described that the role of the facilitator were:

- To understand the company and its environment
- To facilitate discussions on business objectives, SWOT and PEST analysis
- To manage market sector research
- To facilitate segmentation process

This research was carried out with a dominant element of action learning. Even with academic guidance from the Knowledge Transfer Partnership with the University of Bath, the academic supervisor could not have predicted the failure of using JAS. As such, the potential for bias in influencing the company to move in one particular direction was limited because the study was carried out in light of self-investigation and learning. Through action learning, the researcher reflected on the processes and outcomes of the study. Learning was facilitated when the researcher developed some basic understanding about the research area in the review of the literature as discussed in chapter 2. This case study demonstrated the usefulness of Kolb's experiential learning theory or learning model (1984) as highlighted in chapter 3 (figure 3.1) to understand the researcher's learning experience (illustrated in figure 5.2). The different learning points are discussed in the following pages.

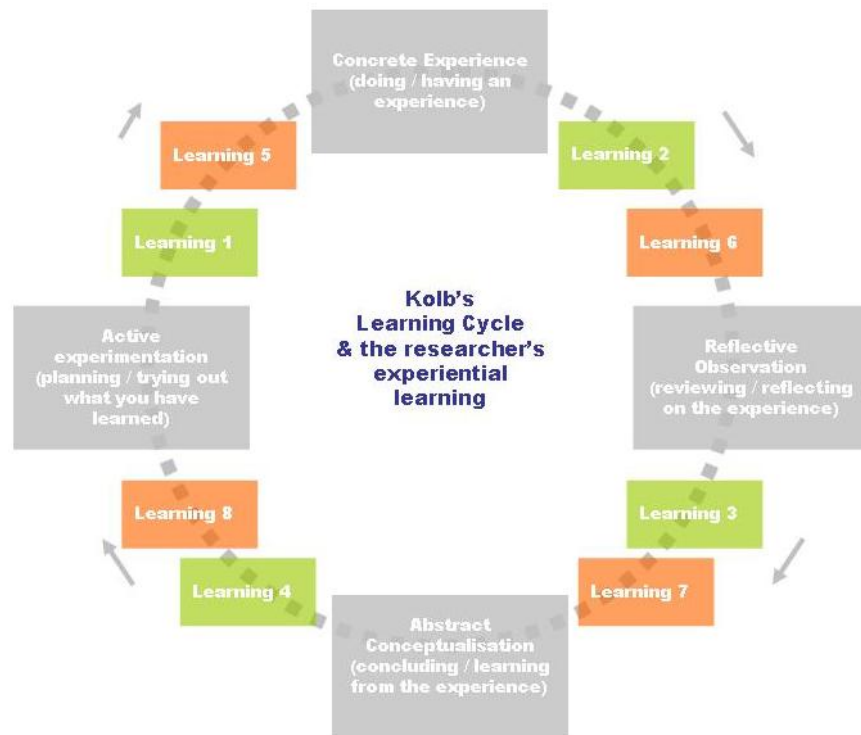


Figure 5.2. Researcher's experiential learning using Kolb's learning cycle (1984)

Learning 1 (planning):

In this case, the researcher developed knowledge of the company and the staff, the services, the market and environments within the first seven months of working in the company. The researcher also developed knowledge from the theory reviewed in chapter 2 and learned that the literature did substantiate the need for segmentation in Eatec. With the uniqueness of each segmentation problem for different professional service companies, models and methods were adapted slightly to suit Eatec's segmentation needs.

Reflecting on this learning, the researcher mapped out the three-stage segmentation model proposed by Dibb and Simkin (1997), a demonstration of 'active experimentation' (Kolb, 1984), and found that although this was a useful guide for managers to follow, the researcher felt that stage B (strategic thinking) of the model provided insufficient guidance to users. The model advised users what to do (i.e. determine new/revised market segments), but not how to do it (i.e. how to evaluate and select between equally favourable segments). Reflecting upon the understanding from the literature review, the researcher learned that a set of structured systems was required to guide the segmentation process.

Learning 2 (doing):

At the beginning of the process, the Directors understood the purpose of the planning process and were willing to participate in the group discussions, and agreed that staff should take part in certain brainstorming sessions as well. The researcher observed that these brainstorming sessions were useful to provide staff with a sense of involvement in the whole strategic marketing development process, but it was also noted that staff took to these moments as an opportunity to express feelings of discontent about the company's lack of investment in personal and professional development, as well as insignificant software capabilities in-house.

Learning 3 (reflecting):

Reflecting on the experience from learning point 2, the researcher learned that initiating a segmentation scheme resulted in a rippling effect that impacted on issues and areas, which may not necessarily appear to be directly linked with the task at hand. The researcher was aware of this. To ensure that feelings of uncertainty about the researcher's presence with the company were eliminated, segmentation objectives were clearly communicated. The researcher listened to opinions, reflected this back into strategic plans and had provided regular progress reports.

Learning 4 (concluding):

Following from the experience gained during the above learning point, the researcher concluded that facilitator intervention was valuable in this case study. Having an 'outsider' manage the process had 'opened up' staff to participate with views that are in fact important managerial issues. Issues which otherwise may not have been disclosed if the process was managed by the Directors. At the same, the researcher being a participant enabled a thorough understanding of the issues set within a real life context, rather than a facilitator that came by once in while.

Learning 5 (being active again):

During stage 1 of the segmentation process, the researcher needed to carry out market sector research in order to develop sector knowledge to assist with the evaluation and selection process. The researcher learned from past business records as well as from the Directors the market sectors that Eatec have been active in as well as those they would like to be involved in. This was a useful learning process as the researcher had to consider what has been learnt so far within the company and understand what might be required from the market sector reports to aid with the evaluation and selection process.

Learning 6 (doing segmentation):

From the learning gained from points 1 to 5, the Directors and the researcher along with the academic supervisor (from the knowledge transfer partnership) agreed that a multi-criteria decision making (MCDM) approach should be adopted and to use JAS to assist with the judgmental and evaluation process. The experience gained at this stage of the segmentation process was a sour one. The JAS system seemingly failed in this context but in the planning stages, it was agreed by all participants that JAS was an appropriate tool. From this experience, the researcher made an attempt to understand what went wrong.

Learning 7 (reflecting on experience):

The researcher reflected on the experience gained in point 6. The researcher did not feel the MCDM approach using JAS failed because the actual results did not suggest so (as explained in section 5.2.1).

The researcher developed an understanding that if a user is not comfortable with the process, then it is likely that a user would have doubts about the results. This would be the plausible explanation as both JAS and the 8x8 matrix provided similar market sector results (differed on one) and yet the Directors seemed more satisfied with the results of the alternative approach as it was less structured and therefore intuitively more appealing.

The researcher also learned from this that adopting structured approaches to the decision making and evaluation process of market segmentation was not idealistic within this case study because the results from a multi-criteria decision stemmed from a number of stimuli. This was explained in section 5.2.1. This learning and understanding reinforces the fact that small companies do incorporate the use of intuition and experience (Palmer and Millier, 2004) in decision making processes and thus evaluation tools should not be structured and rigid.

The experience of others (e.g. Islei et al., 1991, 1999; Lockett and Naudé, 1996; Naudé et al., 1997) assisted with the researcher's learning, which suggested that JAS worked for similar settings, but ultimately it was reflective observation that drove the researcher's learning cycle.

Learning 8 (concluding):

Concluding from the research experience, the researcher learned that the facilitation of a segmentation process requires the respect, trust, commitment and enthusiasm from all staff. These conclusions are obviously not new in itself in the context of business-to-business segmentation, but the experience and problems encountered throughout does put theory into practical realistic settings and strengthens the action learning. It is also the presence of a facilitator that ensures the segmentation was held together.

The researcher was advantaged in this case study as there was motivation on a personal level to perform well for career development and to achieve an MPhil from the research. As an MPhil research student, there was enthusiasm to inject academic schemes of segmentation into realistic business settings. Equally, as a Knowledge Transfer Partnership Associate, the researcher was keen to inject a real-life segmentation case study to a research area that has received limited attention in the extant literature.

This was also a learning process for the Directors by helping them through the segmentation process, the Directors have been “learning by doing”. Although the Directors might have felt that the segmentation exercise had not been all that effective, they experienced the development in knowledge to a certain extent, the same way the researcher has gained experience. The Directors were able to develop further knowledge and understanding in three areas: their business, the marketplace and their clients.

5.4 Summary

The researcher concludes this discussion with optimism. The researcher feels that this study has demonstrated knowledge transfer using expertise from the university, the researcher and the company participants. Each contributor has learnt something by being involved in the segmentation process and has gained new knowledge and experience.

It was unfortunate that JAS failed from the Directors' point of view because it has worked for other business settings. However, one could take an optimistic view that as a result, the Directors have learned from that experience. As a result, an alternative method was created, which the Directors felt were more appropriate to their situation whilst adopting the multi-criteria decision making approach. The key point to remember is that one method cannot fit all. Each company will have their own individual purpose for segmenting the market and a segmentation that works for one purpose might not be sufficient for another (Freytag and Clarke, 2001).

The underlying foundation to successful implementation of a segmentation scheme in this case was to 'reflect on experience', in contrast to just experience alone. It will no doubt take several years to change the company into one that can fully embrace the changes and benefits of segmentation planning, but the researcher agrees with Dibb (1998) that a segmentation 'process' is intended to be devised for a longer-term purpose. As such, the researcher hopes to have assisted the company on the path to delivering a successful segmentation plan for the future.

Chapter 6

Conclusions and Recommendations

6.1 Research conclusions

The literature review suggests a number of structured segmentation models which can be adapted and implemented by practitioners in different business environments. In the context of this case study, the researcher needed to address how Eatec could evaluate and select their market sectors using a measured approach.

This research suggests that while a structured segmentation process is important to ensure that all marketing and business development initiatives are integrated into one process, the actual evaluation and selection stage cannot be too structured.

Elements of various academic approaches were employed to meet the research objective. These included:

- **Goller et al. (2002)** structured and integrated segmentation framework
- **Lockett and Naudé (1996)** MCDM / Ranking / Intuition
- **Palmer and Millier (2004)** Intuition / Matrix evaluation

It was appropriate to adopt an action learning approach for this research because guidance on how to evaluate and select between equally favourable markets within a business-to-business context was limited. Moreover, guidance based on theory may not necessarily be applicable to unique situations (Freytag and Clarke, 2001). Problems encountered in this case study were real and so solutions developed were real and specific to the context. As such, generalised conclusions from single case studies to other cases are not encouraged but could be made to theories.

The learning points gained from this case study are:

1. Facilitator intervention
2. A method cannot be too structured in the evaluation process
3. There are two ways to selecting market sectors
4. Barriers to segmentation (commitment, enthusiasm and cooperation)

Without a doubt, *facilitator intervention* was important in this case study to ensure that the segmentation process was held together. The advantages have been highlighted throughout the case and are summarised below:

- At times when a lack of enthusiasm and faith in the evaluation tool or segmentation process could have hindered the process, the facilitator as a participant already has an understanding of the environment and thus was able to work on the problem to find an alternative and effective solution.
- When it became necessary to carry out long-winded tasks, a facilitator maintained that focus to avoid losing sight of the segmentation objective. However, the researcher must stress that the subsequent segmentation process to segment target clients was not managed particularly well as explained in section 5.2.3. The importance of this stage was overlooked by both the researcher and academic facilitators. Thus there was a lack of sufficient planning or understanding for this stage. The difficulties that the researcher came to face (*commitment, enthusiasm and cooperation*) have already been indicated as general *segmentation barriers* by Palmer and Millier (2004), that even if managers undertake and achieve an appropriate segmentation process, they still have to rely on colleagues in other departments to implement the actions arising.
- The researcher as a facilitator with an understanding of academic schemes of segmentation, and as an employee of the company was essential to bridge potential barriers between segmentation theory and what can realistically be applied to a real life context.

A professional service company like Eatec, who operates in diverse market sectors with capabilities that can be applied across sectors, finds it difficult to agree on an appropriate evaluation and selection process. On the one hand, individuals are faced with a strong desire to rely on intuition and personal experience, but on the other they are nervous of the lack of a measured approach using concrete marketing intelligence. When faced with this dilemma and pressures from managerial demands, it is often the need to be rational about business decisions that wins the upper hand regardless of their intuition or experience. However, it is the ability to amalgamate intuition with marketing intelligence within a selection and evaluation process that makes an intuitive contribution valuable (Bonaneau, 2003).

In this case study, evaluation was required on a number of levels. When a decision maker was faced with the prospect of evaluating eight market sectors with seven services, as well as to consider attributes of each market sector, the marketing intelligence of each market sector and an intuitive input, the tool (*JAS*) that was adopted to assist with the judgmental and evaluation process *became too structured for this complex decision making process*.

The researcher was able to make sense of this ‘thinking’ process when similarities were found with the Stimulus-Outcome model (Kotler, 1992) but within a business-to-business segmentation context. By facilitating the segmentation process and participating in day to day discussions, the researcher was immersed in the research, its problems and surroundings. As such, the researcher was able to develop an in-depth understanding of this informed behaviour and thus contributing to academic theory with an explanation to why sometimes segmentation evaluation may fail. Subsequently, the development of an evaluation and selection approach (8x8 matrix) that was deemed successful in amalgamating intuition with marketing intelligence to counteract the recognised barriers was developed. This initiated a practical guidance to how similar companies could carry out the evaluation and selection for equally attractive decision alternatives.

The researcher was surprised to learn that the devised 8x8 matrix can also be used to select market sectors using a ‘needs/benefits segmentation approach’ (Bonoma and Shapiro, 1984) if so desired by managers. This was not intentional as the alternative approach was devised so that it worked on a utility points system by ranking tabulated scores, but the researcher has highlighted in section 5.2.2 how a practitioner could *develop needs/benefits segmentation strategies by analysing the evaluation data within the matrix grid*. A needs/benefits approach was not adopted by Eatec in this case. Nevertheless, the fact that the researcher has identified that through the use of this simple evaluation matrix, decision makers have a choice to make their segmentation scheme as sophisticated as required to suit their company situation is a valuable finding and contribution to theory as well as management.

6.2 Suggestions for further research

6.2.1 Long term effects and benefits

Evaluate the long term effects and benefits as a result of instigating the segmentation process, including changes to company growth.

6.2.2 Comparison studies

Comparison studies with other small companies to assess the similarity in situation such as difficulties faced during the segmentation process

Comparison studies with large engineering organisations to understand if the difficulties faced in Eatec was only common with small companies (where there was a limitation in resources and financial constraints). If there are similarities between the small and large company, this may imply that difficulties faced in a segmentation process are due to the complexity of professional service companies dealing with wide variety of services applicable across various sectors.

6.2.3 Test out the methods and process developed in this case study

A follow up study using the methods and processes described in this case study in an alternative case study to explore if the process is more manageable and successful. The success of the follow up study would suggest that a method to suit all is feasible.

6.3 Industrial recommendations

Small companies need to adopt a structured segmentation approach to manage a successful and integrated process. The researcher has found that the framework provided by Goller et al. (2002) to be useful for this case study. The advantage of developing an integrated framework of segmentation helps to pull together business objectives, marketing intelligence and marketing initiatives into one integrated process. The following points highlight recommendations when managing future segmentation processes:

Facilitator

Although a facilitator is strongly recommended, the Directors or decision makers must understand and support the need for commitment to the development and implementation of the segmentation process. There is a need to adopt mutual respect and trust between the researcher, management and implementation team.

Intuition

Experiential knowledge played an essential part in the evaluation and selection process of the market sectors. Although total reliance on intuition was not a robust option, it could be used to a great advantage if it were combined with other sources of information. This overall experiential knowledge should then be integrated into the segmentation process. Experienced individuals have a huge amount of experience and that, if utilised correctly with the appropriate evaluation tools, could provide accurate predictions of future market trends and changes.

Involvement of all staff

Staff from different areas of the business or engineering discipline should be encouraged to participate in the process because each area would, in some form be affected by the decisions made. As illustrated in this case study, engineering staff provided valuable input into the brainstorming sessions. These brainstorming sessions could also aid communication and integration of teamwork, as well as to avoid the creation of an 'Us' and 'Them' divide between staff and the facilitator.

Understanding business needs

The decision makers, facilitators and implementors involved with the segmentation process must understand the business needs. The pre-segmentation stage although took longer than anticipated, it is a recommended stage to clearly map out existing gaps so that an appropriate segmentation strategy can be developed to suit the needs of the business context.

Define costs and plans

At the end of the process, the allocated budget was not fully spent. The Directors and facilitators had not expected the pre-segmentation stage to take so long. From this learning, it is recommended that managers and facilitators develop a clear idea of *realistic* time plans and costs associated to manage each task effectively so that each task receives the appropriate time, attention and financial support required.

Reviewing strategies

The market is not static. Reports carried out may become dated and trends may change so segmentation plans need to be reviewed constantly. As the segmentation process becomes more sophisticated and facilitators more experienced, a company will eventually be able to adopt a needs/benefits segmentation approach with strategies that are client driven.

Bibliography

Bartels, R. (1967). A Model for Ethics in Marketing. *Journal of Marketing*, **31** (1), pp 20-26.

Bonabeau, E. (2003) Chief Scientist, Icosystem Corporation. Article prepared for Cap Gemini's summer 2003 Edition of Focus e-Zine [www.cgey.com]

Bonoma, T.V. (1985). *The Marketing Edge: Marketing Strategies Work*, Free Press, New York, NY.

Bonoma, T.V. and Shapiro, B.P. (1983). *Segmenting the Industrial Market*, Lexington Books, Lexington MA.

Bonoma, T.V. and Shapiro, B.P. (1984). Evaluating market segmentation approaches. *Industrial Marketing Management*, **13**, pp 257-268.

Brace, I. (2004). *Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research*, London, Sterling VA.

Brownlie, D. and Spender, J.C. (1995). *Managerial Judgement in Strategic Marketing*. *Management Decision*, **33** (6), pp 39-50.

Brooksbank, R. (1999). The theory and practice of marketing planning in the smaller business. *Marketing Intelligence & Planning*, **17** (2), pp 78-90.

Brown, H.E., Shivishankar, R. and Brucker, R.W. (1989). Requirements driven market segmentation. *Industrial Marketing Management*, **18**, pp 105-12.

Bryman, A. and Bell, E. (2004). *Business Research Methods*, Oxford University Press, Oxford.

Caple, J. and Martin, P. (1994). Reflections on two pragmatists: a critique of Honey and Mumford's learning styles. *Industrial and Commercial Training*, **26** (1) pp. 16-20.

Choffray, J.M. and Lilien, G.L. (1980). *Marketing Planning for New Industrial Products*, J.Wiley, New York, NY.

Coles, G.J and Culley, J.D. (1986). Not all prospects are created equal, *Business Marketing*, May, pp 52-58.

Courtney, H., Kirkland, J. and Viguerie, P. (1997). *Strategy Under Uncertainty*. Harvard Business Review, November-December, pp. 66-81.

Cresswell, J. (1994). *Research Design: Qualitative and Quantitative Approaches*, Sage, CA.

Crittenden, V.L., Crittenden, W.F. and Muzyka D.F. (2002). Segmenting the business-to-business marketplace by product attributes and the decision process. *Journal of Strategic Marketing*, **10**, pp 3-20.

DeWalt, K.M., and DeWalt, B.R. (2002). *Participant Observation: A Guide for Fieldworkers*, Altamira Press.

Dibb, S. (1998). Marketing Segmentation: Strategies for Success. *Marketing Intelligence & Planning*, **16** (7), pp 394-406.

Dibb, S. and Simkin, L. (1997). A program for implementing market segmentation. *Journal of Business and Industrial Marketing*, **12** (1), pp 51-65.

Dibb, S., Stern, P., and Wensley, R. (2002). Marketing Knowledge and the value of segmentation. *Marketing Intelligence & Planning*, **20** (2), pp 113-119.

Dibb, S. and Wensley, R. (2002). Segmentation analysis for industrial markets: Problems of integrating customer requirements into operations strategy. *European Journal of Marketing*, **36** (1/2), pp 231-251.

Doyle, P. (1995). Marketing in the new millennium. *European Journal of Marketing*, **29** (13) pp 23-41.

Eden, C. and Huxham, C. (1996). Action research for management research, *British Journal of Management*, **7**, pp 75-86.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research, *Academy of Management Review*, **14** (4), pp 532-550.

Engle, J.F., Fiorillo, H.F. and Cayley, M.A. (1972). *Market Segmentation: Concepts and Applications*, Holt, Rineholt and Winston, New York, NY.

Esslemont, D. (1996). Segmentation and targeting, *Elmar Internet Discussion Group*, University of South Carolina (elmar@sc.edu)

Freytag, P.V. and Clarke, A.H. (2001). Business to business market segmentation. *Industrial Marketing Management*, **30**, pp 473-486.

Gill, J and Johnson,P. (1991). *Research Methods for Directors*, London, Paul Chapman Publishing.

Greene, W.E., Walls, G.D. and Schrest, L.J. (1994). Internal Marketing: The key to external marketing success. *Journal of Services Marketing*, **8** (4), pp 5-13.

Grönroos, C. (1996). Relationship marketing: strategic and tactical implications, *Management Decision*, **34** (3), pp 5-14.

Gummesson, E. (2003). All research is interpretive! *Journal of Business & Industrial Marketing*, **18** (6/7), pp 482-492.

Hague, Paul. (2002). *Market Segmentation in B2B Markets* [online]. Available from: <http://www.b2binternational.com/whitepapers3.htm> [Accessed 18 July 2003]

Hammermesh, R.G., Anderson, M.J. and Harris, J.E. (1978). Strategies for low market share Businesses. *Harvard Business Review*, **56**, pp 98.

Hooley, G.J. (1980). The Multivariate jungle: the academic's playground but the manager's minefield. *European Journal of Marketing*, **14** (7), pp 379-386.

Hunt, S.D., Chonko, L.B. and Wilcox, J.B. (1984). Ethical Problems of Marketing Researchers. *Journal of Marketing Research*, **21** (3), pp 309-324.

Islei, G and Lockett, A. G. (1988). Judgmental Modelling Based on Geometric Least Squares, *European Journal of Operational Research*, **36** (1), pp 27-35.

Islei, G., Lockett, G., Cox, B., Gisbourne, S. and Stratford, M. (1991). Modeling Strategic Decision Making and Performance Measurements at ICI Pharmaceuticals. *Interfaces*, **21** (6).

Islei, G., Lockett, G., and Naudé, P. (1999). *Judgemental Modeling as an aid to scenario planning and analysis*, *Omega*, **27** (1), pp 61-73.

Jocumsen, G. (2004). How do small business managers make strategic marketing decisions? *European Journal of Marketing*, **38** (5/6), pp 659-674.

Johnson, G. and Scholes, K. (1993). *Exploring Corporate Strategy*, 3rd edition, Prentice Hall, Hemel Hemstead.

Khatrri, N. and Ng, H.A. (2000). The role of intuition in strategic decision making. *Human Relations*, **53** (1), pp 57-86. Sage Publications, London, Thousand Oaks CA, New Delhi.

Kolb D.A. (1984). *Experiential Learning experience as a source of learning and development*, New Jersey, Prentice Hall.

Kotler, P. (1992). *Marketing Management*, 7th ed., Prentice-Hall International, Englewood Cliffs, NJ. pp.161-4.

Kotler, P. and Keller, K.L. (2005). *Marketing Management*, Upper Saddle River, NJ, Prentice Hall.

Lockett, A.G. and Islei, G. (1989). JAS-Judgemental Analysis System, Version 1.2, Manchester Business School, UK.

Lockett, A. G., and Naudé, P. (1996). On the Development of New Forms of Organizational Decision Support Systems. *International Transactions on Operational Research*, **3** (2) pp 117-128.

McDonald, M.H.B. (1989). *Marketing Plans - How to Prepare Them, How to Use Them*, Butterworth-Heinemann, Oxford.

McDonald, M. and Dunbar, I. (1995). *Market Segmentation*, Macmillan Press, Basingstoke.

McNiff, J. (2002). *Action research for professional development: Concise advice for new action researchers*. [online]. Available from: <http://www.jeanmcniff.com/booklet1.html> [Accessed 27 February 2007]

Meadows, M. and Dibb, S. (1998). Assessing the implementation of market segmentation in retail financial services. *International Journal of Service Industry Management*, **9** (3).

Millier, P. (2000). Intuition can help in segmenting industrial markets. *Industrial Marketing Management*, **29**, 147-155.

Mitchell, V.W. and Wilson, D.F. (1998). Balancing Theory and Practice. *Industrial Marketing Management*, **27**, pp 429-445.

Mintzberg, H. (1973). *The Nature of Managerial Work*, Prentice-Hall, Englewood Cliffs, NJ.

Mowen, J. and Gaeth, G. (1992). *The Evaluation Stage in Marketing Decision Making*. Journal of the Academy of Marketing Science, **20** (2), pp 177-187.

Naudé, P., Lockett, A. G., and Holmes, K. (1997). A Case Study of Strategic Engineering Decision Making Using Judgmental Modeling. *IEEE Transactions on Engineering Management*, **44** (3), pp 237-247.

Palmer, R.A. and Millier, P. (2004). Segmentation: Identification, intuition and implementation. *Industrial Marketing Management*, **33** (8), pp 779-785.

Piercy, N. (1992). *Market-led Strategic Change*, Butterworth-Heinemann, Oxford.

Plank, R.E. (1985). A critical review of industrial market segmentation, *Industrial Marketing Management*, **14**, pp 79-91.

Powers, T.L. (1991). *Modern Business Marketing: A Strategic Planning Approach to Business and Industrial Markets*, West Publishing, St Paul, MN.

Reason, P. and Bradbury, H. (2001). *Handbook of Action Research*, Sage, Thousand Oaks, CA.

- Reason, P. and Rowan, J. (1981). *Human Inquiry*, Chichester, John Wiley & Sons.
- Richardson, B. (1995). In Defence of Business Planning. *Small Business & Enterprise Development*, **2**, pp 41-57.
- Robertson, T.S. and Barich, H. (1992). *A successful approach to segmenting industrial markets*, Planning Review, **20**, pp. 4-9.
- Robson, C. (1994). *Real World Research*. Oxford, Blackwell.
- Saaty, T.L. (1980). *The Analytic Hierarchy Process*, New York, McGraw-Hill.
- Sanger, J. (1996). *The Complete Observer*, London, Falmer Press.
- Saunders, J.A. (1987). *Marketing and competitive success*, in: Baker, M. (ed.), *The Marketing Book*, Butterworth-Heinemann, Oxford.
- Shaw, E. (1999). A guide to the qualitative research process: evidence from a small firm study. *Qualitative Market Research: An International Journal*, **2** (2), pp 59-70.
- Slater, S.F. and Narver, J.C. (1994) *Business Horizons*. March-April. Available from: http://findarticles.com/p/articles/mi_m1038/is_n2_v37/ai_15419777 [Accessed on February 2008]
- Sollner, A. and Rese, M. (2001). Market Segmentation and the Structure of Competition: Applicability of the Strategic Group Concept for an Improved Market Segmentation on Industrial Markets. *Journal of Business Research*, **51** (1), pp 25-36.
- Walker, R. (1985). *Applied Qualitative Research*, Hampshire, Gower Publishing Company.
- Webster, F.E. (1991). *Industrial Marketing Strategy*, John Wiley & Sons, New York, NY.
- Weinstein, A. (1987). *Market Segmentation*, Probus Publishing, Chicago, IL.
- Weinstein, K. (1995). *Action learning - A journey in development and discover*, London, Harper Collins.

Weinstein, A. (1994). *Market Segmentation: Using Demographics, Psychographics and Other Niche Marketing Techniques to Predict and Model Consumer Behaviour*, Probus Publishing, Chicago, IL.

Wind, Y. and Cardozo, R. (1974). Industrial market segmentation, *Industrial Marketing Management*, **3** (2) pp 153-66.

Yin, R.K. (1994). *Case Study Research – Design and Methods*, *Applied Social Research Methods Series*, 5, Sage Publications, London.

Young, S., Ott, L. and Feigin, B. (1978). Some practical considerations in market segmentation, *Journal of Marketing Research*, **15**, pp. 405-12.

Zimmerman, A. (2002). *Flexibility and variety in the use of case studies* [online]. Available from: http://www.findarticles.com/p/articles/mi_qa4062/is_200209/ai_n9099467 [Accessed 23 February 2007]

Appendix 1

Appendix 1 - SWOT and PEST analysis

PEST analysis defined

A PEST analysis (or otherwise known as an environmental analysis) was carried out to understand how the environment could affect the company's situation in terms of politics, economic changes and issues, social issues and technological issues. This process involved various brainstorming sessions with the directors and staff. Feedback was collated and summarised by the researcher below. Points and issues raised at the PEST brainstorming sessions are broken down to three trends:

- Significant trends that affected Eatec
- Trends which needs to be monitored
- Trends which are not applicable to Eatec

Points covered in each trend are listed and discussed briefly below.

Significant trends that affected Eatec

Political
Litigation: With increasing litigation throughout society, the requirement for analysis of products, both at the design stage to minimise the chances of failure and post failure to determine the cause of failure, was likely to increase. With the growing trend for consumers to take legal action against suppliers, it may be the case that consumer goods manufacturers have the greatest need to understand the behaviour of their products.
Research and Development Tax credits: It was felt that this is an area possibly benefiting Eatec, but further information was required on this issue.
Economic
Reduction in time to market: It was felt that this was a significant trend. For example the 3-day car programme, which was difficult to implement but fruitful if successful. In order to reduce development time, more analysis/simulation will be required.
Public transport/Freight expansion (British rail industry): There was strong agreement that the government was encouraging or making major investments in this area, in particular the rail sector. It was also mentioned that there was an increase in international trade and this may affect international freight. Therefore, there may be a growing market for monitoring of transportation, which was due to be studied as a mini project.
Reduction in the number of tier 1 suppliers: There was a major trend in the reduction of tier 1 suppliers, as demonstrated by BT who cut their suppliers from 17,000 to 8,000 (quoted by Eatec directors). It was felt that Eatec would

<p>have to target tier 1 or lower tier suppliers. It is possible that by working for suppliers who are tier 1 or lower, Eatec's profit margins may be squeezed.</p>
<p>Consumer goods are becoming technically more complex and competitive: There was a trend for consumers to require equipment to have more functionality and hence to be more complex, and often to be more compact etc. In addition, expectations relating to robustness and reliability were increasing. Competition was increasing and hence there was pressure on manufacturers to produce equipment more cheaply.</p>
<p>Joint Ventures/Consortia: It was felt that Companies were forming joint ventures or consortia in order that the group can provide a wider range of services, and hence can tender for larger and more wide-ranging projects.</p>
<p>Consolidation of companies/sites in UK and Europe: It was felt that companies are merging sites. This may affect Eatec as it could lead to:</p> <ul style="list-style-type: none"> • Central research centres may be set up, which have more in-house facilities and capabilities • Reduced number of possible clients • Possibly larger research centres would look to use a small number of large consultancies which provide a wide range of services
<p>Social</p>
<p>Health and Equipment / Performance Measurement: The government has increased the budget for the NHS. It was felt that this area might provide good potential for Eatec. In addition, as people live longer, more medical aid is required, and there may be potential with respect to athletics equipment and monitoring systems.</p>
<p>Technical</p>
<p>Reduced head count: Generally there appears to be a trend to reduce the number of engineers employed by companies. This means that contractors / consultancies have to be used more in order to meet timescales, and to address the skill requirements. However, in some instances, the trend was the reverse. British Energy was using large numbers of contractors, but because of quality issues has decided to recruit more employees.</p>
<p>Reduced in-house skills / time: It was felt that there was a trend for clients' engineers to be less prepared to undertake analytical work themselves, but would rather put it outside. This may be due to:</p> <ul style="list-style-type: none"> - not having the skills - lack of time - performing more of a project management role
<p>Reducing numbers of students studying engineering at Universities: There was a trend of fewer students studying mechanical engineering at universities. This trend may have a positive effect on Eatec because companies will have greater difficulty in recruiting good engineers, and hence may use consultancies more. However, Eatec may have greater difficulty in recruiting suitable people.</p>
<p>Trends regarding applications and techniques: There was a wide range of possible applications and this was increasingly becoming wider. It may be difficult for companies to keep up to date with what is available, and hence this</p>

may be an opportunity for Eatec. However, which techniques are growing was not clear and hence needs to be looked in further. Possible methods include looking at the trends in sales of software (e.g. CFD, neural networks), and if possible, who the users were.

Increasing expectations of users of measurement / simulation systems:
Users of measurement, simulation and similar systems are continuing to expect better functionality and user interfaces. Also there was a trend for systems to be used by less skilled people, and hence they must be easier to use and more foolproof. Therefore, there may be opportunities for Eatec to work with producers of equipment / systems to enhance the processing of results and user interfaces etc.

Trends which needs to be monitored

Political

EU regulations coming into force in the UK affecting new and existing products. It was recognised that although it was not a trend that can be acted on at present, Eatec should monitor new standards and consider the implications / opportunities.

EU regulations / grants:
EU regulations may allow Eatec to more fairly compete in Europe. Incentive schemes and EU sponsored contracts may be available.

Air travel:
Public perception of threats in the current war climate may continue to reduce air travel, for example. This might reduce demand for continuing high technology development of new aircraft and related services. It was agreed that the air travel industry was affected but this trend does not seem to affect Eatec directly but perhaps would be useful to monitor.

<p>Price of oil:</p> <p>It was understood that spending on research in the oil industry was closely linked to the price of oil. Therefore, it was worth monitoring the price of oil and the expected future trends in order that we are aware of what may happen to research budgets.</p>
<p>Defence expenditure:</p> <p>Investment in defence projects may increase. However, where the money was to be spent was important to Eatec, as its services may not be of interest if the investment was in low technology areas. Contracts for Eatec were likely to come from tier 1 or lower level suppliers.</p>

Economic
<p>UK energy consumption/generation:</p> <p>There were issues raised regarding nuclear power but it was not really a trend Eatec could act upon. Therefore, it was agreed as a 'watch this space' point.</p>
<p>Recycling:</p> <p>Changes to the materials were used to aid the recycling process, and the quality of the recycled material will change the mechanical properties. It was agreed that it would be difficult to analyse what the trend is for this point. It was stated that it is an area that Universities are addressing at this stage.</p>
<p>Effects of developing countries:</p> <p>As the developing countries increasingly develop their own products, rather than being manufacturers for western countries, competition will grow. With the developing countries cost advantages, it will be necessary for UK and European companies to supply products that are perceived as being of higher quality. This is likely to require additional and more sophisticated engineering, which could provide opportunities for companies like Eatec. Although western companies are increasingly relocating their manufacturing to the developing countries, it was felt that generally engineering / research was continuing in UK / Europe.</p>
Social
None recorded
Technical
None recorded

Trends which are not applicable to Eatec

Political
None recorded
Economic
<p>The Euro:</p> <p>It was felt that joining the euro was someway off and more of a future scenario rather than a trend. Broadly beneficial to manufacturing and maybe beneficial to Eatec so a continuous monitor on this issue was useful.</p>
Social
<p>Modular housing growth:</p> <p>Although growing, this is not an area that was applicable to Eatec.</p>

Technical
Research and Development performed by clients in-house: New work and contracts will be difficult to secure, current ongoing arrangements may be suspended. This was not felt to be a trend and hence would not contribute to the strategic planning.
Fragmented R & D market: The R&D market will become even more fragmented as competition increases. This allows us to manoeuvre. This was not felt to be a trend and hence would not contribute to the strategic planning.
Eatec's lack of expertise in development of hardware/software may be a disadvantage. This was felt to be more appropriate for the strengths and weaknesses aspect of the strategic planning.
Lack of knowledge or training in engineering regulations and standards: A lack of knowledge may threaten Eatec's credibility as companies look for consultants with experience in dealing with the relevant standards. This was felt to be more appropriate for the strengths and weaknesses aspect of the strategic planning.
Eatec's diverse in house skills and learned expertise can lead to novel work on new contracts. This was felt to be more appropriate for the strengths and weaknesses aspect of the strategic planning.

Brooksbank (1999) emphasised that analysing PEST factors would allow any new opportunities or threats emanating from the wider world be anticipated and acted upon. The PEST analysis has identified that is a likely growing requirement for analytical work, with a significant role being played by external contractors. Aspects that would influence this included:

- The growing trend towards litigation means companies need to be confident in their products and be able to prove they acted appropriately during the design/development stages
- Significant pressures to reduce time taken to design/develop products
- Reduction in the number of in-house engineers
- Reduction in the tendency of in-house engineers to perform analytical work, particularly within small and medium sized companies
- Number of engineering graduates leaving British universities is falling

This therefore suggests that Eatec needed to develop key accounts with external contractors in order to be well placed for the growing requirement of outsourced analytical work. The primary focus of key account management is to orchestrate the inter-company relationships so as to ensure the attainment of mutually beneficial goals of increased sales and profits. Therefore, with the reduction of in-house engineers, Eatec would be in a better position to

target themselves to specific market sectors of medium sized companies. Preferably with contractors and be embedded within these inter-relationships as part of the supply chain. This could be achieved by establishing a process or agreement to add value on a consistent basis with key clients. When evaluating and selecting target markets and subsequently target clients through to business development, the directors need to consider the issues raised from the PEST analysis.

SWOT analysis defined

A good SWOT profile facilitates the development of a strategy which capitalises on a company's strengths, minimises weaknesses, exploits emerging opportunities and avoids threats. Hence a SWOT analysis was carried out which involved various brainstorming sessions with the directors and staff. Although SWOT is generally analysed in each of its own element (strengths, weaknesses, opportunities, threats), the researcher recorded that discussions naturally led strengths to be opportunities, and weaknesses to be threats. Therefore, the feedback collated below summarises strengths as opportunities and weaknesses as threats.

Eatec Strengths and Opportunities
Flexible and adaptable company, which can respond quickly to new opportunities and requirements
Staff work well together, supporting and assisting each other to solve problems and meet deadlines
Good at retaining clients and therefore an opportunity to develop long term partnerships
Strong customer base- small but important group of clients with continual demands
Low overheads, hence charges can be maintained at a competitive level
Use well respected software and have a detailed knowledge on the application of it
Innovative- plenty of fresh ideas for solving complex problems, combined with strong engineering appreciation
Eatec's staff has a range of contacts that should be cultivated. An opportunity for new business
Can list a number of major companies as satisfied customers
Have a history of work in a wide range of industries and applications, which gives potential customers confidence
Professional approach adopted- we always complete projects in the best way possible even if we have underestimated the work required

Complementary mix of experience/talents/backgrounds/qualifications of staff, enables a wide range of simulation capabilities to be offered
Reputation for high quality work. Opportunity to build on this reputation through word of mouth amongst engineering associates
Testing to support and validate simulation work can be undertaken

Eatec Weaknesses and Threats
High dependence on core clients, threat to lose key business
Reactive- much of Eatec's work is reactive following leads that 'fall out of the sky'. This is a threat to the company's future, no planning.
Do not invest in speculative investments enough
Current lack of structured training which reflects the personal development of staff. Threats are de-motivated staff.
Poor at developing ongoing relationships with clients. Frequent contact needs to be made and a debriefing document to be considered after each project which addresses possible future opportunities with the client or others in the industry
Lost opportunities- often a novel idea is started and not followed through to conclusion
Poor at assessing market opportunities- areas for growth are sometimes pursued that lead nowhere and others with potential are identified too late
As a company there are fewer management tiers which leaves less room for progression into management
Lack of marketing, the threat is, there is no plan or focus on how to develop new services, skills, markets
Relatively small in terms of number of staff and range of engineering services, which could cause problems as some customers are increasingly looking for a one stop shop
Have not achieved 3rd party certification to ISO 9001
Do not have extensive expertise of any industry and its requirements except for the drill bits industry
Lack of expertise in certain areas like high end graphics programming
Software development procedures may not be as comprehensive as potential clients would expect. Have limited track record in software development which will make it difficult to sell to new customers

Points raised which were not strengths or weaknesses but worth noting
Close relationship with a number of Universities
Some Companies would prefer to work with local consultants, hence Eatec would need to

reflect this in its marketing where appropriate
May be difficult to attract suitable staff due to Eatec's location– location appears to be unattractive to some
May be difficult to attract suitable younger engineers due to lack of expected formal grading structure for newcomer to see his/her way 'up' through the 'system' (a traditional / 'big-company' view but it still exists)
May be difficult to attract suitable staff - fewer engineers available with qualifications and/or experience required with realistic salary and career aspirations to suit Eatec's needs
New customers may resist giving new type of work to Eatec with limited or no history of commercial project work

These SWOT factors would facilitate the development of subsequent marketing strategies. Focusing on Eatec's strengths, the analysis identified that the company obtains a complementary mix of experience and talents which enables a wide range of simulation capabilities to be offered. The company should market themselves as innovators with regards to the solution of complex problems combined with a strong sense of engineering appreciation. The company obtains a history of applying simulation techniques/testing in a range of industries and thus part of the marketing strategy should aim to promote this specialist area to enhance the confidence of potential clients.

With regards to Eatec's weaknesses, Eatec is relatively small in terms of number of staff and range of engineering services, which could cause difficulties if potential clients are looking for a "one-stop shop". The part of the analysis suggests that Eatec should aim to target a few market sectors only working on its strengths as identified above. Eatec should aim to improve its current weakness of not having good long-term ongoing relationships which create repeat businesses. By aiming only a few sector helps to create credibility in a particular market and in the long-run become market experts.

Appendix 2

The Aerospace Industry

Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

Market Research: The Aerospace Industry

Table of Contents

1.	Introduction to the UK aerospace industry	3
2.	The UK Space Industry	7
3.	Skills adopted in the Aerospace Industry	13
4.	Finding the source of the skills	20
4.1	Dr. Gary Lock- University of Bath	19
4.2	Gareth Evans- Avionic Services Plc (UK)	25
4.3	Dr. Valerie Crute- UK Lean Aerospace Initiative (UK LAI)	27
5.	Conclusions	29
	Appendix 1- UK and European Aerospace: Main mergers and joint ventures UK	31
	References	33

Table of Figures

Figure 1.	Changing supply chain relationships	4
Figure 2.	Changing supply chain relationships- current trends	4
Figure 3.	Trends in Supply Chain Structure	5
Figure 4.	Figure demonstrating UK Space Industry	8
Figure 5.	Space related turnover of UK companies	9
Figure 6.	Consolidated turnover by market sector 1996	9
Figure 7.	Consolidation in the European Space Industry	10
Figure 8.	Advert taken from Airbus website 2002	13
Figure 9.	Part of the various specialised function of Airbus adapted from details on adverts	17
Figure 10.	Example of general Aerospace Industry Structure	20
Figure 11.	Diagram demonstration of the top down and bottom up approach of interviewing	21
Figure 12.	Diagram demonstration of the comparison of the Bath University applications in Mechanical and Aerospace Engineering	24
Figure 13.	Diagram demonstration of Avionic Services within aerospace industry supply chain	26
Figure 14.	Diagram demonstration of General Aerospace Industry Supply Chain	28

Market Research: The Aerospace Industry

1. Introduction to the UK aerospace industry

The aerospace industry is a major wealth creator for the UK. In 1997, the UK aerospace industry had a total turnover of over £15 billion and second only to the US in the world (The Society of British Aerospace Companies, SBAC). European collaboration has been the focal point of much of UK aerospace activity since the early 1960s. A diagram of the main mergers and joint ventures of the UK and European aerospace within the last decade is illustrated in Appendix 1.

Globally, the equipment sector is the biggest and most fragmented element of the aerospace industry. Despite the relatively small size of most of the players in the sector, British industry occupies first or second place in a number of market segments. The UK equipment sector is in first place overall in Europe, and has over 12% of the world-value market (SBAC). This suggests that there is a potential market for business development in industries related to the main aerospace production such as the equipment sector.

A recent survey of aerospace executives by Deloitte and Touche (Goldberg, 1999) showed that globalisation was the one priority reason for the use of integrated CAE technology and has made an influence on growth and commercialisation of new product development (Dr. Ian Chatting, 2001). There is also a recent focus on global costs, which combined with emergent technological capability has created the opportunity to develop and adopt entirely new methods of working, generating significant scope for new research in the aerospace industry (Dr. Ian Chatting, 2001).

The aerospace industry is also a global industry in terms of market, production and increasingly capital. SBAC commented that this trend will accelerate into the next century and will lead to the dilution of national ownership, especially amongst civil and military prime contractors.

It is unfeasible for a single organisation to develop an aircraft in isolation due to the heavy costs involved in the making of a modern aircraft. Therefore, relationships and operation of an extended enterprise within a complex supply chain is often key to the success of any individual programme. As the industry is based on a few large

Market Research: The Aerospace Industry

programmes, the success or failure of the whole organisation can rest on the performance of any particular project (Chatting, 2001).

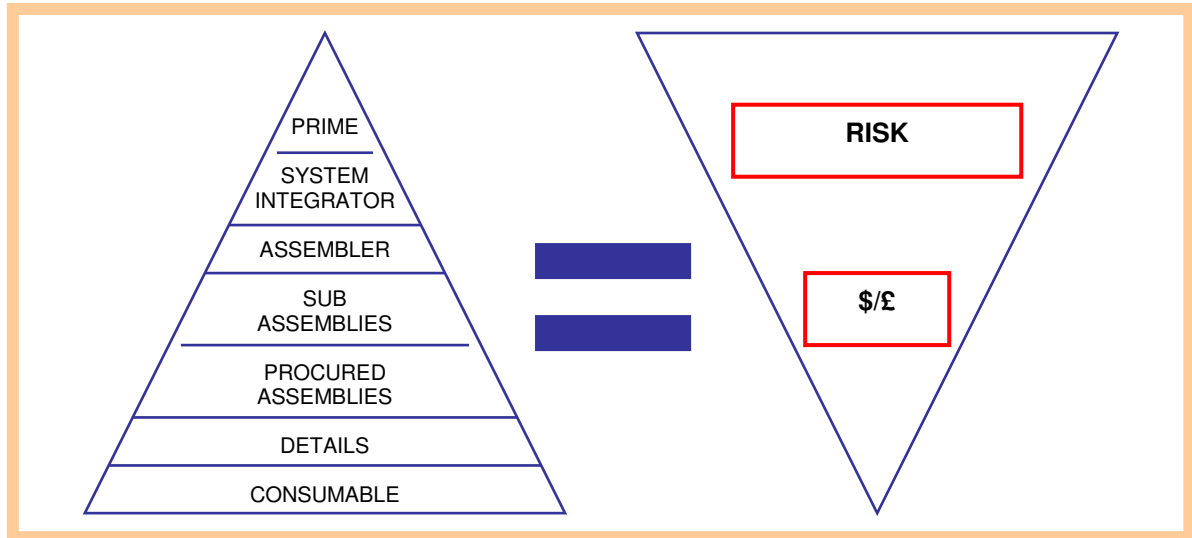


Figure 1: Changing supply chain relationships, Source Mills (1995)

Figure 1 demonstrates the number of organisations or component at each level. It shows the position prevailing up until the early nineties and shows that the lower tier suppliers who manufacture a large number of parts earn relatively low return but take a minimal risk at the base of the triangle (Chatting, 2001). Investment risks gets higher as an organisation moves further up the supply chain but with an increasing potential for higher profits.

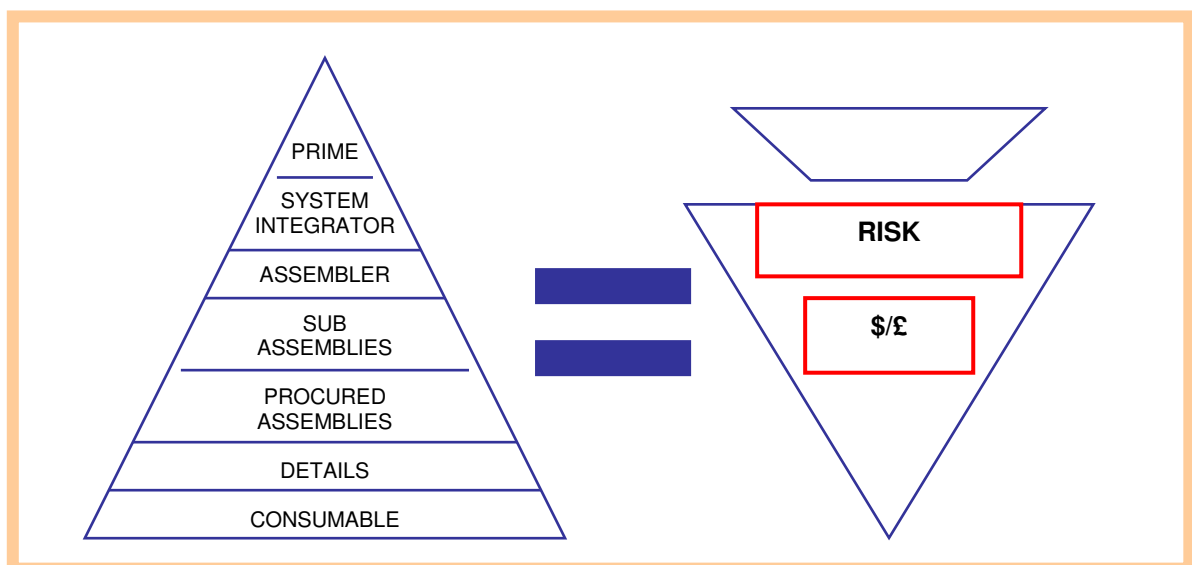
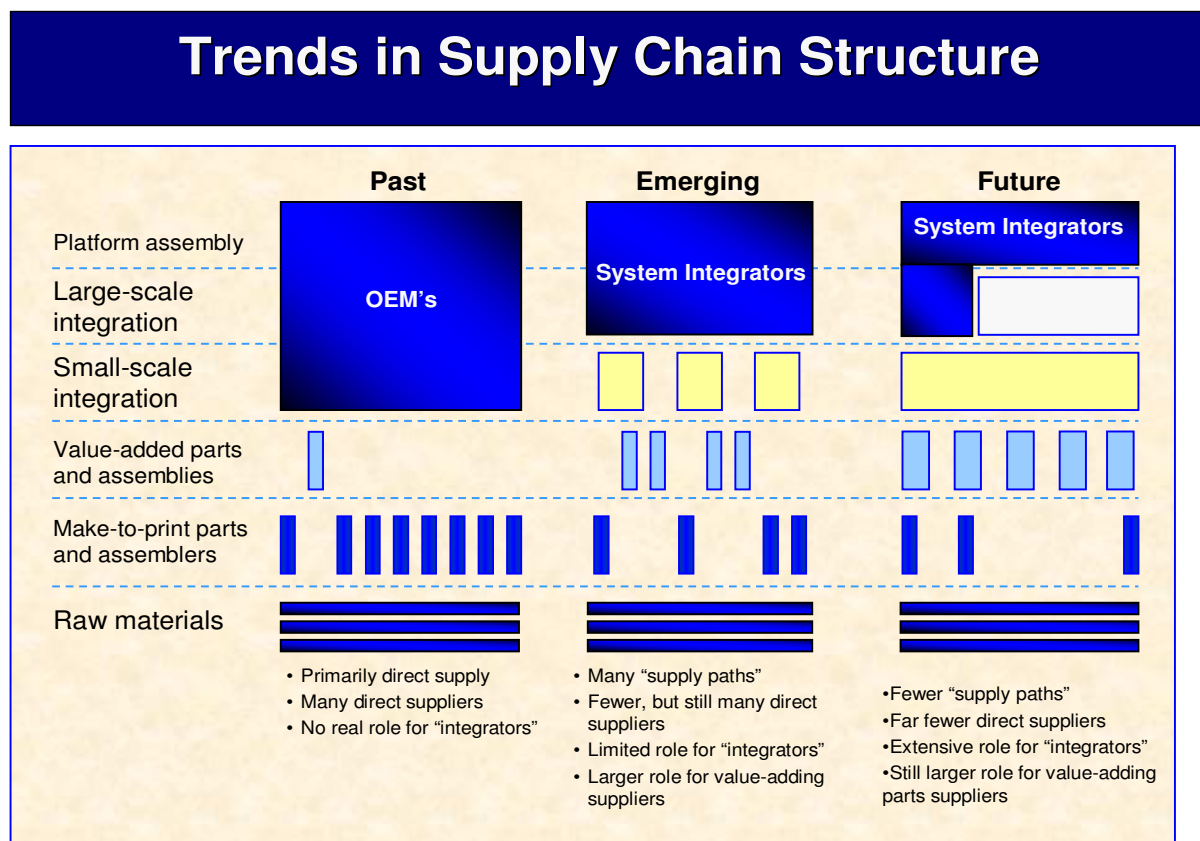


Figure 2: Changing supply chain relationships- current trends, Source Mills (1995)

Market Research: The Aerospace Industry

Due to the increasing cost of launching aircraft programmes, the supply chain relationship has changed (figure 2). The figure demonstrates that the suppliers of assemblies and sub assemblies are asked to contribute towards the cost of aircraft launch in order to create a market for their products (Chatting, 2001). A.T. Kearney and SBAC demonstrate another interpretation of the changes in the supply chain structure in figure 3.

A recent global study of manufacturing industries by Deloitte & Touche (Velocci, 1998) showed that smaller manufacturers are becoming the major innovators in the complex aerospace supply chain (Chatting, 2001) as a result of the impact of the aerospace industry and supply chain restructuring. The study claimed that, “The pressures to innovate are being felt all along the supply chain- prime contractors are leveraging their power over suppliers, requiring them to invest in R&D and share in product development cost.



A.T. Kearny

Figure 3: Trends in Supply Chain Structure

Market Research: The Aerospace Industry

More recently on May 7th 2002, Lufthansa chose to select the Rolls-Royce Trent 900 Engine to power its new fleet of Airbus 380s (M2 Presswire via Comtex, UK Government. 2002). This brings about a tremendous vote of confidence in manufacturing which indicates a more rapid than expected recovery after the events of September 11th (DTI Minister, Brian Wilson- May 2002). Mr. Wilson also goes on to quote, “This order is excellent news for the economy, and excellent news for Rolls Royce. The order will also benefit companies further down the supply chain.”

This certainly is good news for Eatec as Wilson suggested, these developments will benefit companies further down the supply chain.

Market Research: The Aerospace Industry

2. The UK Space Industry

The UK Space industry is made up of commercial organisations, and builds on expertise in academic and government bodies. Most space business in the UK is fully commercial. The military component of this business has been important for more than 20 years, but increasingly the civil component is tending to dominate (Stephen Fisher- Logica UK Limited 2002). The level of government funded R&D programmes, including space science has been static or declining for about 15 years but still plays an important role in underpinning new technologies and increasing public awareness of space. UK universities and associated institutes are particularly strong in the space field and many private research organisations provide a bridge between academia and the commercial world. The result is an innovative, growing, export-oriented and globally competitive space industry (www.ukspace.com).

The United Kingdom space industry web site describes the structure as follows:

- The UK has one prime contractor with the capability of designing both large and small spacecraft and spacecraft subsystems, and two companies which build small satellites and subsystems. More than 30 companies are suppliers of spacecraft equipment, ranging from high performance thrusters and attitude sensors, through RF filters and multiplexers for communication payloads, to gallium arsenide solar cells and precision instruments for gathering Earth observation data. The combined turnover of these companies is in excess of £70 million per year.
- In the ground segment field, 10 companies are prime contractors, turning over more than £130 million per year. Particular expertise lies in supplying spacecraft control centres and simulators, as well as satellite communication network facilities. Further 20 or more companies are involved in the supply of ground segment subsystems, equipment and software, with a combined turnover of over £60 million per year.
- A group of more than 50 companies provide consultancy and contract research and development skills in a wide range of specialist areas, including feasibility studies of technology and systems as well as support in policy-making and procurement. Taken together, their turnover is more than £40 million per year.
- A growing group of more than 10 companies are engaged in Earth observation data processing, which turns raw results into useful information for end users. This new business is already worth nearly £20 million per year.

Market Research: The Aerospace Industry

The diagram below (figure 4) was drawn for the purpose of this report to demonstrate the industry structure described by UK Space.

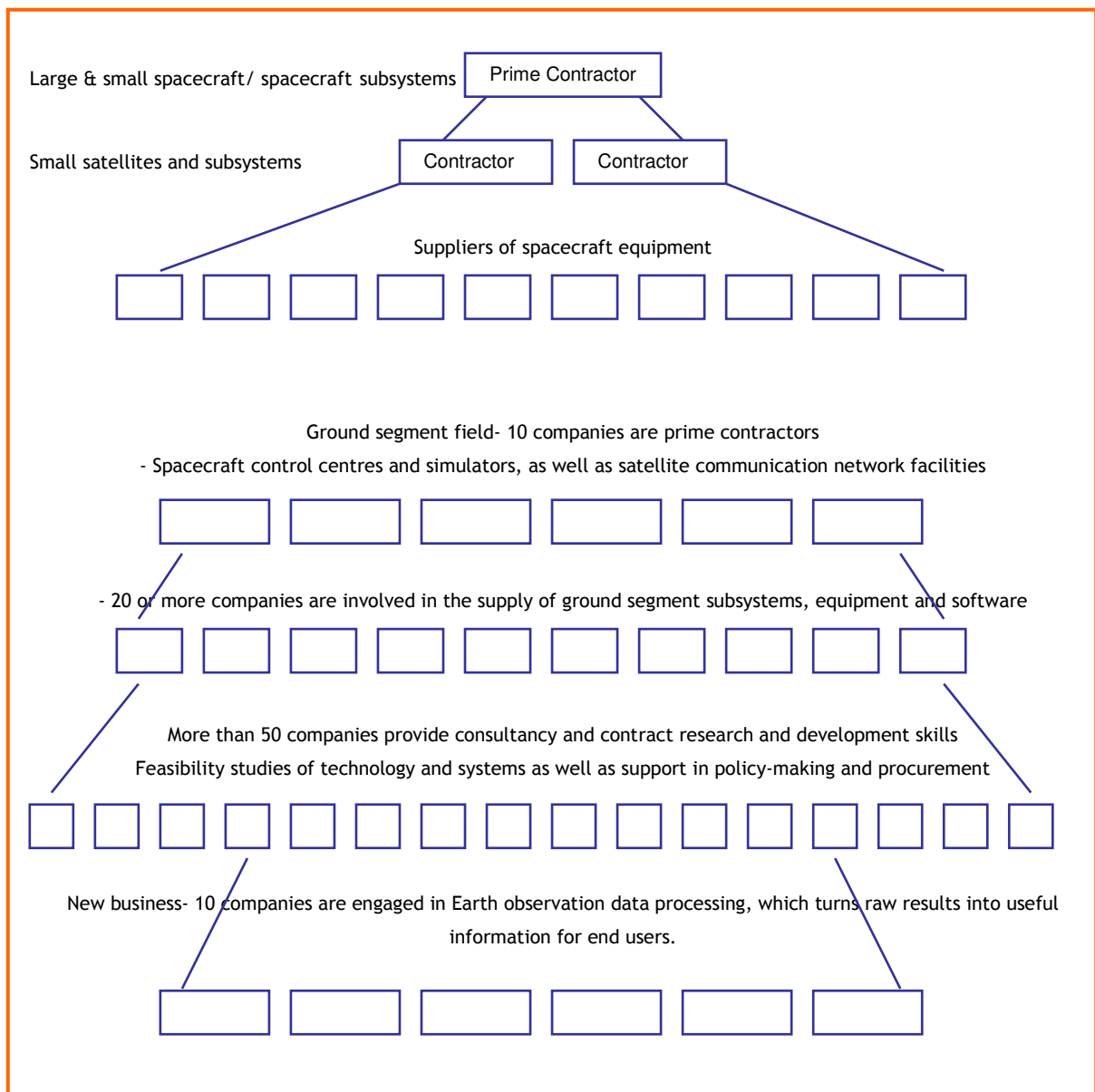


Figure 4: Figure demonstrating UK Space Industry

Market Research: The Aerospace Industry

In 1996, the space related turnover of UK companies covered by various categories listed in figure 6 was estimated to be as follows:

Total turnover	£740 million
Real consolidated turnover (total turnover less contracts between space companies)	£618 million
Real value-added turnover (total sales less value of subcontracts)	£506 million

Figure 5: Space related turnover of UK companies, Source- www.ukspace.com/overview.htm

The breakdown of the consolidated turnover by market sector was as follows 1996:

Telecommunications	52%
Earth observation-related	29%
Space science	6%
Space transport	3%
Other	10%

Figure 6: Consolidated turnover by market sector. Source- www.ukspace.com

Communication satellites (including navigation) and military satellites as written in the DTI July reports suggested that this area would dominate the space sector. Although earth observation satellites will account for only less than 10% of the market, communications growth will be driven by a rapidly expanding telecom market as suggested in the table above of the breakdown of the consolidated turnover by market sector 1999. This will be triggered by new application areas such as Internet and digital radio and continuing technological improvements.

Market Research: The Aerospace Industry

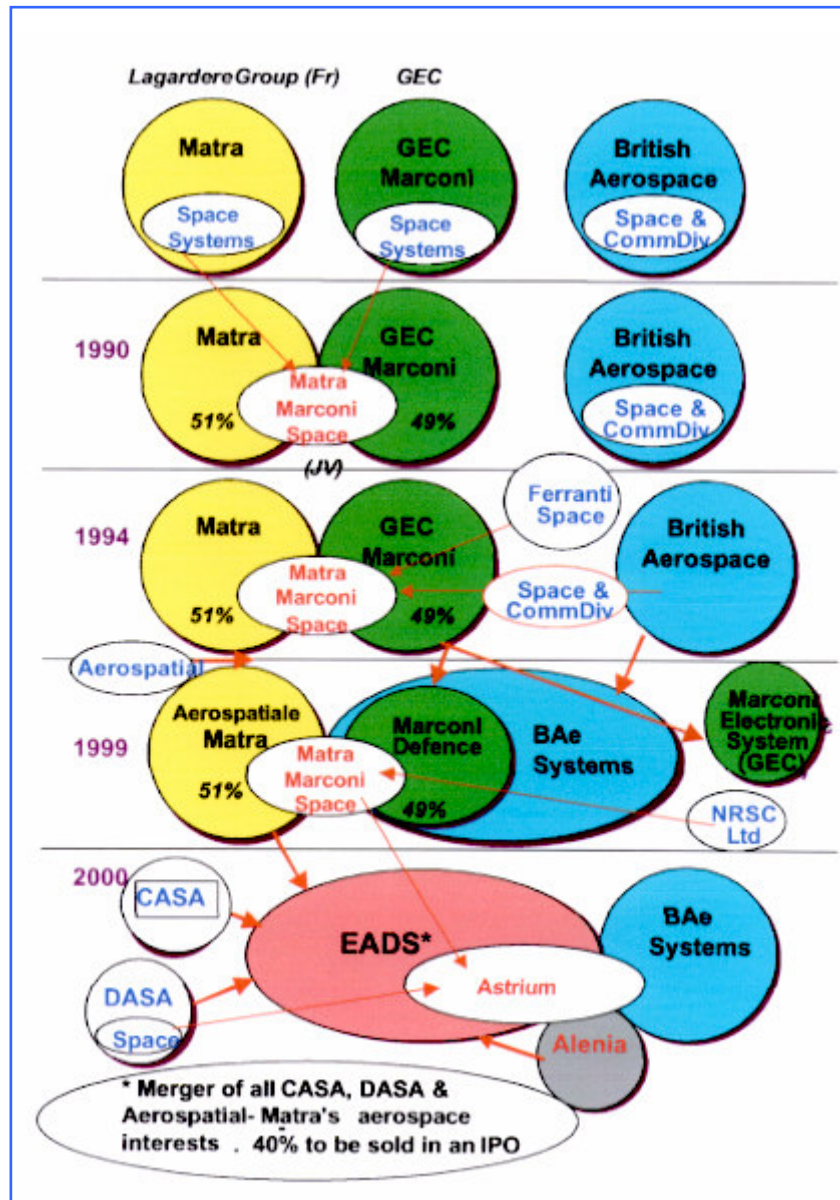


Figure 7- Consolidation in the European Space Industry.
Source-http://www.bnsc.gov.uk/assets/dti_030501v2momods2.pdf

Since 1990, due to the result of the drive for scale in the aerospace industry, the global space industry has undergone a significant and rapid consolidation (DTI Report, 2001).

Presented in figure 6 are the key phases and milestones in the consolidation process of the UK Civil Space Activity (Albone, D., Henry, P., Titley, B. DTI Report, July 2001).

A number of software companies have developed software products for other space markets and non-space uses, e.g. ground segment software being used in the water industry; mission control software being used in flight simulators. A number of

Market Research: The Aerospace Industry

companies are active in the US markets, although this remains a very difficult market to break into and exploit (DTI Report, 2001). Hence, it may be even more difficult for Eatec unless good relationships have been established in the UK.

Logica Limited UK develops advanced simulation software for the next generation of UK military satellites for the UK Ministry of Defence (Logica, 1999). The development of antennae technology by another small UK company forms part of a systems integration packages but it is also widely used by news broadcasting organisations for gathering news and transmission from mobile ground stations (DTI Report, 2001). The UK space industry has a number of segments which are still in its very early research stages such as the Earth Observation user market and some parts of the satellite communication and navigation equipment (DTI Report, 2001). It is seen as a potential for spinning out benefits because it is still a growing area and is a long way off before saturation.

Although it is still a growing industry sector, a recent paper published in the Aviation week & Space technology (March 18, 2002), wrote that there is inadequate government funding of research and technology, which will jeopardise Britain's future as a pre-eminent player in both the defence and commercial aerospace markets according to the U.K. industry association. Keith Hayward of the Society of British Aerospace Companies head of economic and political affairs told Aviation Week & Space Technology Magazine that Britain's success in the aerospace sector is built on the foundation of national level research and technology investment. Therefore, a number of Britain's University's often carry out their own research and possible grants may be obtained for certain programmes.

Cranfield Aerospace Ltd. at the Cranfield University carries out engineering and fatigue analysis for the aerospace, defence, rail, power and automotive industry. The techniques often used are fracture mechanics, thermal modelling, and design optimisation to name just a few for the Finite Element Analysis area as well as Computational fluid dynamics. A new package called X-Fatigue is used to calculate fatigue life from strain time histories using the Rainflow cycle counting algorithm (Dr. James Routh, Project Engineering Manager, 2002).

Market Research: The Aerospace Industry


Although it was noted that the Earth Observation user market is still in its embryonic stage, new developments at NASA's Ames Research Centre have recently adapted codes to manage CFD calculations for aeronautics design work and applied them to Earth Science Applications, speeding supercomputer simulations of hurricane formation. (Morrison F. Aviation Week & Space Technology, Aug 6 2001). The advance is that the techniques are taken from aeronautics and applied to Earth Sciences, which from a mathematical standpoint is very similar (Feiereisen, W. Chief of the Advanced Supercomputing Systems Div. At Ames.

Market Research: The Aerospace Industry

3. Skills adopted in the Aerospace Industry

Certain industries are very reluctant to talk about company information and in this study, a different approach was adopted instead of the usual interview/cold calling method, to understand the kinds of skills and techniques used in the present aerospace industry in relation to services and expertise offered by Eatec.

By viewing the appointment section from the Internet or newspapers, it is possible to get an idea of the skills that are required in an industry and even understand the type of organisation and structure. Figure 7 is an example of the format, which will be used in this section to gain information about the aerospace skills market. It is a replica of an actual advert used later in this section for analysis.



STRUCTURE ANALYSIS
(Code:E0009-ESA)

Tasks
Member of the Structure Analysis Domain in A-E, which is in charge of the following main tasks: 1. To prepare, update and maintain the A-E Design Manual volumes applying to the stress analysis and strength checking of the aircraft structural components 2. To define, develop, validate and maintain the procedures, methods and computer programs required to perform, with the adequate technical level and effectiveness, the analyses carried out by the Stress Office 3. To validate the external procedures, methods and computer programs in order to permit their utilisation by the Stress Office engineers 4. To prepare and give the courses and seminars for the necessary training of the Stress Office and Material Review Boarding personnel about the procedures, methods and computer programs 5. To supervise and validate the official finite element models created by the engineers of the Stress Office 6. To create the general load models required by the Loads Department in order to obtain nodal loads for the FE models 7. To define and calculate, in collaboration with the Stress Office and the Loads Department, the load cases to be considered in the analysis of the aircraft structural components, selecting the most critical load cases for the different components 8. To supervise and validate the loading introduction in the FE models performed by the engineers of the Stress Office

Requirements
Aeronautical / Mechanical engineer Experience in NASTRAN/PATRAN Experience in stress analysis and strength checking of composite and metallic primary structure Experience in FORTRAN programming Knowledge in JAVA programming Fluent English

◆ The sentence gives the reader an idea about the organisation structure

◆ We can understand the different functions

◆ Skills / technique applied in industry

Figure 7: Advert taken from Airbus website, 2002

Market Research: The Aerospace Industry

Some appointment adverts are not very detailed and so browsing through appointment sections to get ideas about a market is not always useful. A Company would want to avoid disclosing too much strategic related information due to the development of the appointment on the advert to industry competitors.

There is no secret about the aerospace industry research and development and therefore, information regarding skills is often very openly listed as in the advert taken from Airbus Website (figure 7). This method is applicable to the aerospace industry but it could not have been adopted in certain industries such as the consumer goods industry because the consumer goods market is very competitive. For example, when Dyson, the makers of vacuum cleaners, was interviewed for market research phase 1, they were very concerned that none of the information given would be exposed to a potential competitor. If particular techniques or skills used in the research and development stage is exposed, then it may give away the consumer product's 'uniqueness', and this would be a disadvantage to Dyson.

Here are a few recent job vacancy adverts to demonstrate the use of finding out industry skills and techniques through recruitment adverts in the aerospace industry:

Market Research: The Aerospace Industry

Airbus Job Vacancy advert 1:



AERONAUTICAL ENGINEER-STRUCTURAL DESIGN (bourse Européenne Marie-Curie)

(Code:SYS466MAHE)

Tasks

Today the aeronautical international competition induces aircraft manufacturers to anticipate the future market and in this way to study new aircraft configuration. These specific configurations could include, for example, double deck seating functionality still at the project step today but they could become a reality in the coming years. In this eventuality, considering these critical configurations regarding passenger safety, the regulation authorities could ask for specific demonstrations to include in the certification process.

One of the certification conditions would probably be to demonstrate a correct complete aircraft behaviour during a controlled crash. It is obvious, considering such a scenario, that an experimental demonstration would be too expensive and so, the only possible and acceptable way to conduct such an analysis is to perform a finite element modelling. This type of analysis has been used with success since more than 15 years in automotive industry mainly in the design-calculation process to improve the safety of acrs in order to be best prepared to tests and also in order to find solution to face possible evolution of certification rules.

In the aeronautical field, some studies were conducted during the last 5 years, with some success, using finite element modelling. One of the major difficulties in aeronautics is regarding the *very specific problem of riveted junctions modelling, not present in automotive design. This is an interesting problem for which no satisfactory modelling is available today.* This is due to the complexity of the problem combining multiple failure modes in rivets and plates, non linearity, dynamic loading conditions, initial stress field in rivets and plates...These difficulties are to be compared with the expected level of modelling, the number of rivets for which a failure criteria has to be included in a realistic crash modelling being generally between 1 000 and 10 000. These values include to develop a very reduced, efficient and representative rivet model that has to describe the complex behaviour of such a junction. This is the major challenge in this study, which will open the gate to realistic full aircraft finite element modelling and analysis, under a definitude crash scenario.

Requirements

Doctor in mechanical engineering, skills in finite element modelling, non-linear analysis, dynamic calculation.

Your qualification

We are looking for a long training in a company (24 months), a researcher graduated by the higher education.

This section explains to the reader why CAE is used as an alternative to expensive experimental demonstration. Finite element modelling is used to understand aircraft behaviour.

This section explains how the analysis technique has been tried and successfully tested in other similar industries, i.e. automotive industry.

This section explains the problems the industry faces, highlighted in red. No satisfactory modelling is available yet in the market and it will certainly be a beneficial challenge for Eatec to break into this problem.

This section illustrates some of the analysis techniques used in the aerospace industry, which are provided by Eatec services.

Market Research: The Aerospace Industry

Airbus Job Vacancy advert 2:

Stress engineers and Design engineers

(Code:XC/ES)

Tasks

Qualities required: Synthesis, communication, negotiation and ability to work hard. A successful experience in team management is an important point.

Requirements

We hire high graduate aeronautical or mechanical engineers. Ability to work in English language is necessary and knowledge in German will be appreciated.

Your qualification

On aeronautical Stress domain: You are experimented for 3 to 5 years in stress structure finite element on Patran /Nastran software. You handle static, fatigue and damage tolerance. You will have to work as well on metallic as on composite structure. You have to write justification and certification dossier or develop stress methods and tools. On Design domain: You are experimented for 3 to 5 years in the design of complex products(aeronautic, space, automotive...). You worked within multiskill and international team and you are familiar with a 3D CAD system (Cadd5, CATIA V4 or V5, Pro Eng...).

This section illustrates some of the software's that are being used in the industry. Again stress structure finite element is mentioned again as an analysis techniques used in the aerospace industry. It also suggests that skills which are used in aeronautic, space and automotive industry can be applied in this role, which suggests that the skills are more or less adaptable cross industry.

Airbus Job Vacancy advert 3:

STRUCTURE ANALYSIS

(Code:E0009-ESA)

Tasks

Member of the Structure Analysis Domain in A-E, which is in charge of the following main tasks:

1. To prepare, update and maintain the A-E Design Manual volumes applying to the stress analysis and strength checking of the aircraft structural components
2. To define, develop, validate and maintain the procedures, methods and computer programs required to perform, with the adequate technical level and effectiveness, the analyses carried out by the Stress Office
3. To validate the external procedures, methods and computer programs in order to permit their utilisation by the Stress Office engineers
4. To prepare and give the courses and seminars for the necessary training of the Stress Office and Material Review Boarding personnel about the procedures, methods and computer programs
5. To supervise and validate the official finite element models created by the engineers of the Stress Office
6. To create the general load models required by the Loads Department in order to obtain nodal loads for the FE models
7. To define and calculate, in collaboration with the Stress Office and the Loads Department, the load cases to be considered in the analysis of the aircraft structural components, selecting the most critical load cases for the different components
8. To supervise and validate the loading introduction in the FE models performed by the engineers of the Stress Office

Requirements

Aeronautical / Mechanical engineer Experience in NASTRAN/PATRAN Experience in stress analysis and strength checking of composite and metallic primary structure Experience in FORTRAN programming Knowledge in JAVA programming Fluent English

This part demonstrates which department the potential candidate will be walking in. It can also be useful for researchers to understand the company background structure.

This section is useful to understand how the internal company works, how each department works with others. From this advert, it can be understood that the Structure Analysis team works in collaboration with the loads department and Stress Office. This suggests that work is allocated to specialise team and can assist market researchers to develop market target strategies at the right level.

Market Research: The Aerospace Industry

Airbus Job Vacancy advert 4:

LOADS ENGINEER FOR AEROELASTICITY (Code:E0005)

Tasks

The candidate will join a working group intended to determine and analyse the loads and aeroelastic behaviour about aircraft major components. The work should include aircraft parts modelling, loads computation, aeroelastic behaviour analysis and related technical documentation.

Requirements

High degree in aeronautical engineering is required. Speciality in aircraft field should be preferred. Professional experience: Previous experience in aircraft design on some of the following fields should be desirable: Flight mechanics, Loads, Aeroelastics or Aerodynamics Personal skills: Open minded person able to work in a team manner is required. Fully travelling availability, mainly across the Company European sites, is a must. This may include some staying period abroad. Rid of military service

This section is useful to understand the kinds analysis and tests that are being used. Some familiar ones include loads computation and aeroelastic, behaviour analysis.

From the recruitment campaign on the Airbus website, the following structure can be briefly distinguished:

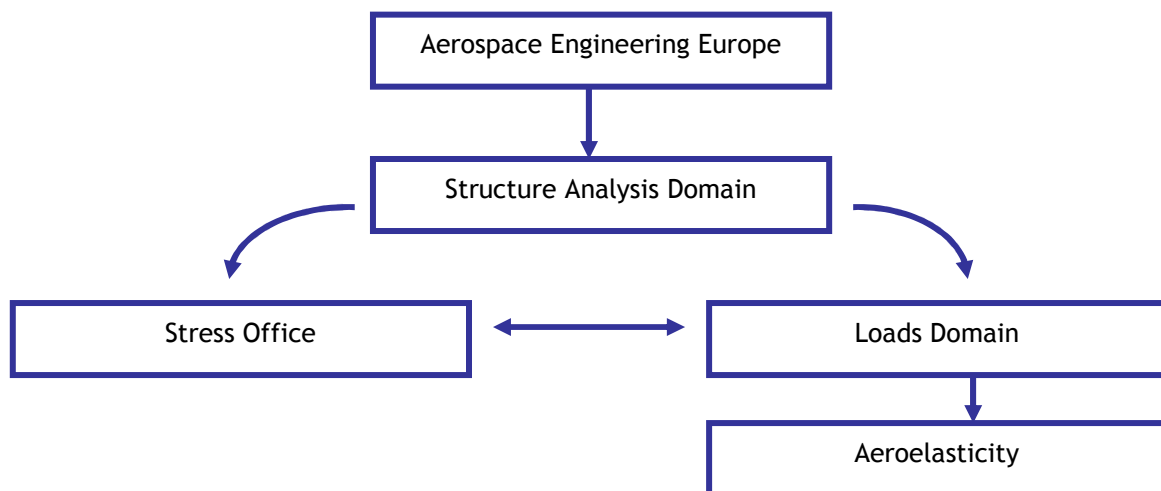


Figure 9: Part of the various specialised function of Airbus adapted from details on adverts, 2002

From the illustrated website recruitment campaign's, much was learnt about the industry techniques, mainly because Airbus is a big player in the industry. This was a useful exercise because a bigger picture can be gained from a bird's eye view as interviewing an individual in the company may result in overload of information in one area only and neglecting an understanding in another area. From the findings, it was found that in order to comply with the static, fatigue and fracture mechanics

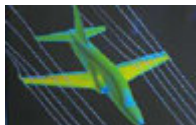
Market Research: The Aerospace Industry

requirements, modelling using FE techniques was used. The introduction of loads in FE models, stress analysis of the structure for static strength checking, fatigue, damage tolerance and residual strength analyses of the structure, preparation of technical documents for the justification and certification of the structure, approval and signature of drawings and solid models are all techniques required in the aerospace industry (Airbus, 2002).

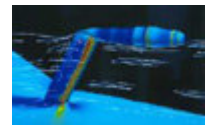
These are the techniques used at the top of the supply chain. Some of which Eatec could assist with.

Another big player is looked at using a similar method to understand if a similar line of technology is adopted in the same industry: BAE Systems.

BAE Systems



For a long time, the only way to test designs for aircraft was to actually fly them, tweak the design by experience in response to perceived problems and then



fly them again (BAE Systems, 2002). In some small medium sized companies, this is still the only way. That is to test their designs by flying them.

A number of companies have brought in the 'wind tunnel' for design testing. Although this did add a new dimension to the work carried out, it was still very time consuming and expensive. "If only there were some way to put the Navier-Stokes used to approximate the flow of fluids to work on aircraft design, then rapid strides might be possible."(BAE Systems, 2002).

The development of the supercomputer changed everything because this allowed CFD tasks to be performed on workstations or even PCs for relatively trivial problems at a faster pace.

BAE Systems use Computational Fluid Dynamics to, " turn the shape of the design model and the surrounding air into a patchwork of polyhedrons, each of which is represented by a set of mathematical equations. The flow going in or out of any one polyhedron is affected by the flow of its neighbours and so all the equations for all the polyhedrons

Market Research: The Aerospace Industry

must be solved simultaneously. Once the equations have been solved, the computer can also be used to assess the aerodynamic properties of the entire design.”

CFD is an important analysis tool in the aerospace industry as well as the techniques named before in discussion of the Airbus case because, “overnight assessments of aircraft are now possible instead of taking many months”. This has also proved to be an important new finding for NASA for Earth Observation activities as described earlier in section 2.

It is inevitable that mechanical engineering techniques play an ever-increasing dominant role in the aerospace industry, and it is about finding the right level of entry to get into the big game.

In the next section, people who also have a role in the aerospace industry supply chain were interviewed to try and understand the broader picture.

Market Research: The Aerospace Industry

4. Finding the source of the skills

4.1 Dr. Gary Lock- Course tutor aerospace engineering, University of Bath.

Mechanical Engineering.

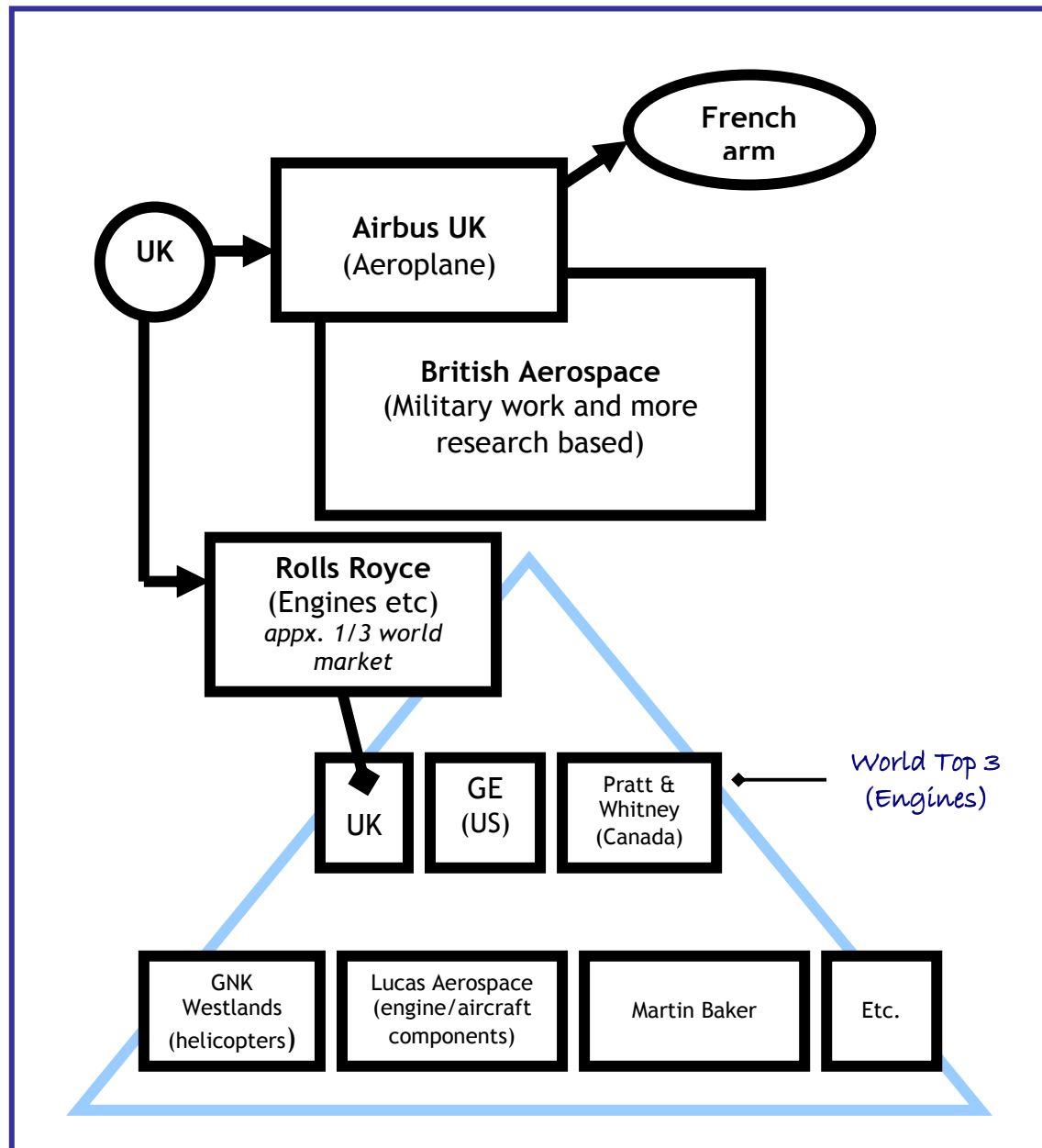


Figure 10: Example of general Aerospace Industry structure, Dr. Gary Lock, 2002

Market Research: The Aerospace Industry

Dr. Lock is currently working as course tutor at the University of Bath, Mechanical Engineering department and has been doing aerospace engineering research for a long time.

In order to understand the kinds of skills the aerospace industry may be using, a different approach was taken to try and gain an insight and understanding from a bottom up approach. Figure 10 was drawn to demonstrate the approach.

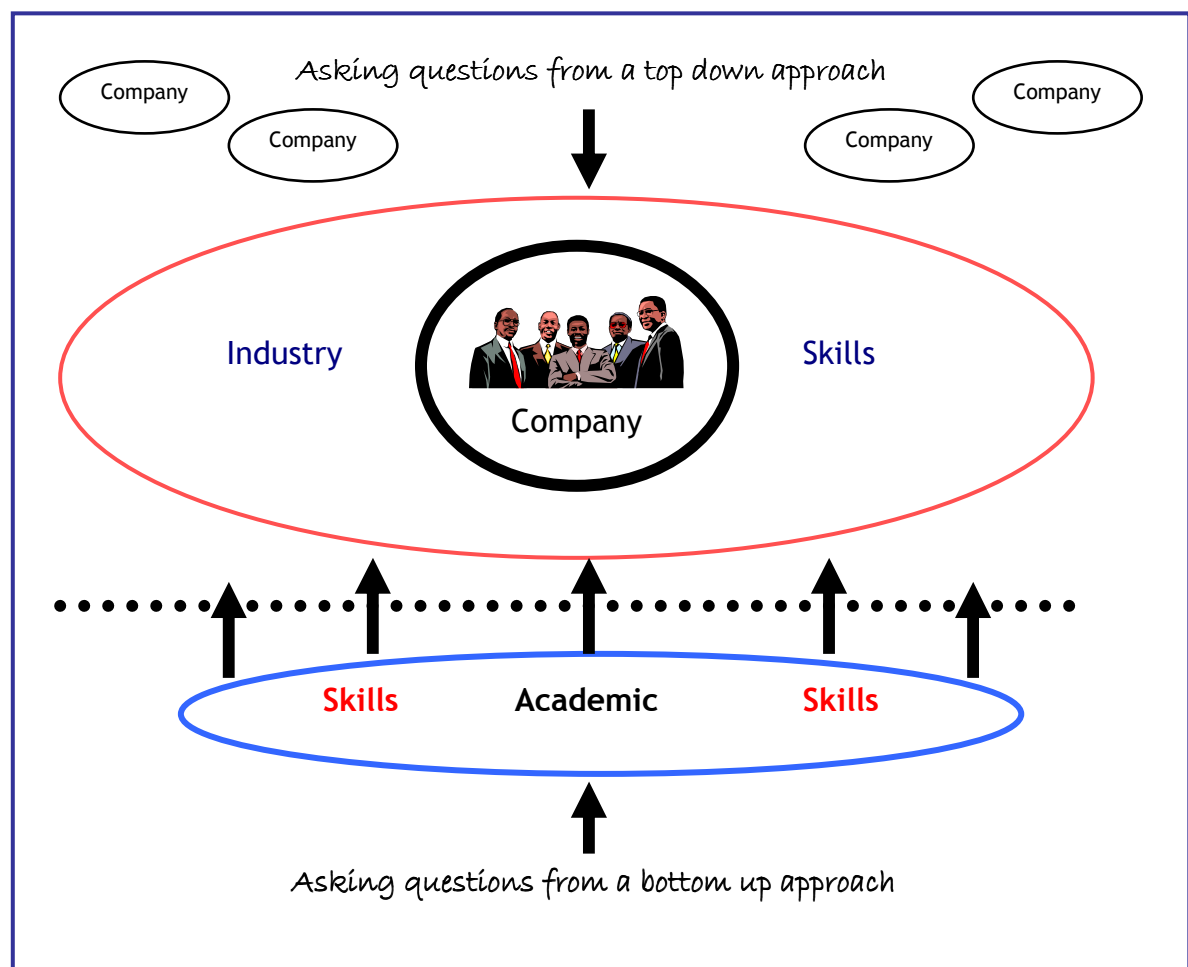


Figure 11: Diagram demonstration of the top down and bottom up approach of interviewing

In most research cases, it is useful to ask questions from a top down approach, for example, "What kinds of mechanical engineering techniques are used in your company?"

Market Research: The Aerospace Industry

However, it is also useful to understand the types of knowledge that is being taught to the mechanical engineering University students, because these are brought into the industries when graduates are recruited. It can also be seen as the source at one end of the stream. If the foundations of what is taught are understood and the number of entrants into the aerospace engineering stream is understood, then it suggests that the industry is continuing to need people, which suggest growing research and development.

Dr. Lock started off describing the UK aerospace industry (figure. 9), where Airbus and BAE (where BAE is a 20% shareholder of Airbus) are the two main players in the UK. The UK aerospace industry is characterised by a large proportion of small to medium sized enterprises (SME), which provide a complete range of components, systems, materials, software solutions etc. This can be demonstrated by the triangle in figure 9, where the main players are only a few at the top, and spans out to a number of SME's providing all sorts of aerospace related services and equipment.

It is inevitable that there is lots of European collaboration in the aerospace industry. Certainly in the defence industry the key players are using a mixture of approaches to ensure that they have a defined position in market access, technological capabilities and management skills (Neal, D.J & Taylor, T., 2001). The differences between countries is suggested that typically, US companies use strategic alliances to gain market access, Western European companies focus on access to technology whilst Japanese companies look for management competencies (Koza, M. 1999).

The main skills widely adopted in the general aerospace industry are computational fluid dynamics, finite element analysis and aerodynamics (Mr. Rob Davies, Project engineering future project team, IMechE at the Western Aerospace Centre). Although

Market Research: The Aerospace Industry

most mechanical engineering students who graduate with those skills often find themselves adaptable to many other streams of engineering namely automotive engineering, manufacturing innovation & engineering design. This suggests that the mechanical engineering taught skills and most of Eatec provided services are applicable across the industry. From the other market research on the other sectors, it is already realised that the automotive industry is a big user of mechanical engineering services and solutions.

Unfortunately, the industry standard pay is not attractive enough to sustain many of the engineering graduates in the same field after graduation. Some are attracted to the wonders of the city where the pay is perhaps double as much as an entry level engineer. The same problem was recognised by the government for the rail industry where there is the lack of engineering talents entering the industry. The industry is already facing an acute shortage of engineers at a time when demand for their skills is at an unprecedented level due to the poor image of the industry (Lee Hibbert, Professional Engineering 2001).

This increasing trend could become an increasing skills problem to the aerospace industry because most aerospace companies are 'self sufficient' (Dr. Lock, 2002). This was also a response from Mr. Rob Davies of IMechE at the Western Aerospace Centre. Quality Control is very important and, "The aerospace companies are overseeing the outsourced projects so carefully that they might as well be doing it themselves." (Dr. Lock, 2002). "Very little is contracted out and little trust is placed on people. Most testing is done in house with in house staff." (Mr. Rob Davies, Project engineering future project team, IMechE at the Western Aerospace Centre). Generally, the respondents are

Market Research: The Aerospace Industry

talking about work, which is high-level research, but even if routine work is contracted out, aerospace companies still want to have a relative control over the project.

Aerospace companies usually recruit from the same place, mainly from the top 10 mechanical engineering departments in UK Universities, and that would be the company's constant pool of talent resource. Universities are a suitable candidate to partner with aerospace companies because Universities receive research money. It also means more control in overseeing quality in projects where special centres are set up (Dr. Lock, 2002).

Of all the different streams of engineering available at the University of Bath, 50% of incoming students choose to study aerospace engineering. With the impact of the September the 11th terrorist attack, there is a noticeable decrease in mechanical engineering course applications. Perhaps it may be due to the dramatic fall in the commercial aerospace market where 17,500 jobs had already been chopped with a further warning of 23,000 more to be axed (Douglas Barrie, Aviation Week & Space Technology- February 4th, 2002. London) resulting in rippling effects of unnerving feelings. But in comparison, the specialist aerospace engineering has had little effect and there is still a significant interest in aerospace engineering.

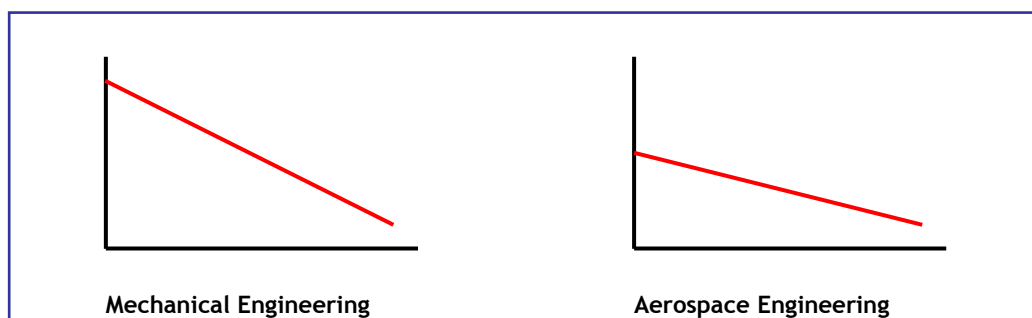


Figure 12: Diagram demonstration of the comparison of the Bath University applications in Mechanical and Aerospace Engineering

Market Research: The Aerospace Industry

Despite the concerns of the impact of the terrorist attacks, the aerospace industry research and development supply chain has continued to grow strongly and this is particularly the case for the defence side of the industry.

4.2 Gareth Evans- Avionic Services Plc (UK)

Gareth Evans works in the aerospace industry for Avionic Services' Consultancy Services. The services range from preliminary investigation and definition to equipment specification and design. The company operates mainly in the airfield systems side. The Company deals with the infrastructures that allow a 747 to land safely, fly safely, communicate safely and vice versa take off safely and be communicated to safely. *“For example, think of the plane as a person and all the senses that a human have, Avionic Services will provide to the aircraft but with the emphasis on safety.”* It also allows the ground personnel, air traffic controllers, and ground movement personnel etc to do their area of job safely.

Market Research: The Aerospace Industry

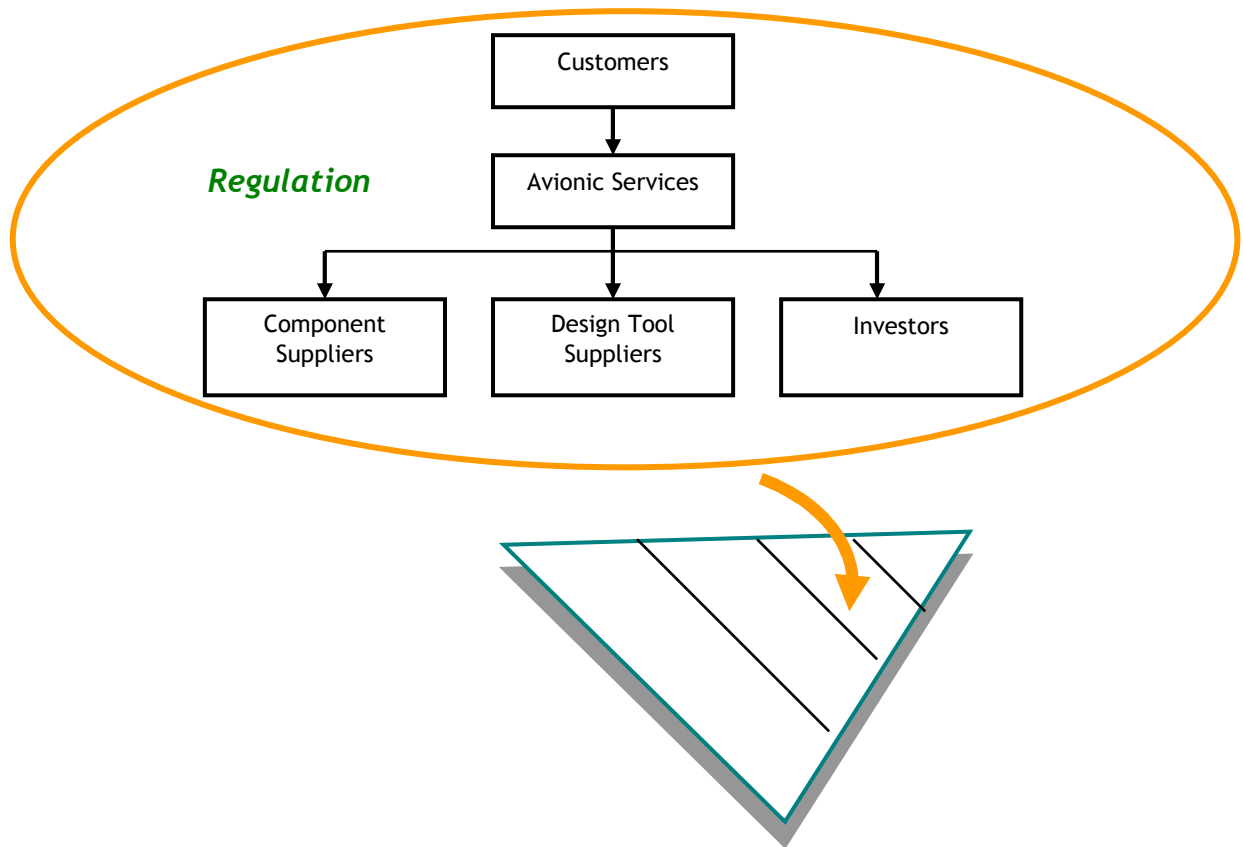


Figure 13: Diagram demonstration of Avionic Services within aerospace industry supply chain

Avionics Services is a provider. Each company would probably have a number of suppliers. Avionic Services have a component supplier who supply them with components to build 'the kit', and design tool suppliers who provides the software simulation tools that allows the company to design radar components and simulate the systems and carry out finite element analysis. Medullary design simulation is also used to simulate radiation properties of certain metals. As well as mathematical modelling the company also carry out in house software development with a hardware design function. Customers higher up the supply chain buy the equipment and investors provide the capital for expansion of the company.

Regulation plays a big influencer in the industry too because it encompasses the whole industry as everything is so critical to safety (Gareth Evans, 2002).

Market Research: The Aerospace Industry

4.3 Dr. Valerie Crute- UK Lean Aerospace Initiative (UK LAI)

The UK LAI was established in April 1998, as part of the SBAC Competitiveness Challenge. The UK LAI is researching the following areas in the UK Aerospace Industry:

- Metrics
- Implementation
- Training

The research at Bath played an important role in establishing Aerospace Performance Metrics for industry benchmarking, identifying barriers and enablers for change and generating industry specific case studies to stimulate shared learning and performance improvement (Bath UK LAI, 2002).

Dr. Crute is a research fellow at the University of Bath, UK LAI. Although Dr. Crute was not as involved as the other respondents with regards to mechanical engineering services, interesting background findings were gained.

The meeting with Dr. Crute provided a better understanding regarding the Aerospace Industry hierarchy as shown in figure 13.

There are two sectors within the aerospace industry; defence and commercial. Both follow a similar chain as in figure 13 and both are in a very highly political market and both are run by programs such as the F-22 program from the US Force, or Eurofighter program.

Market Research: The Aerospace Industry

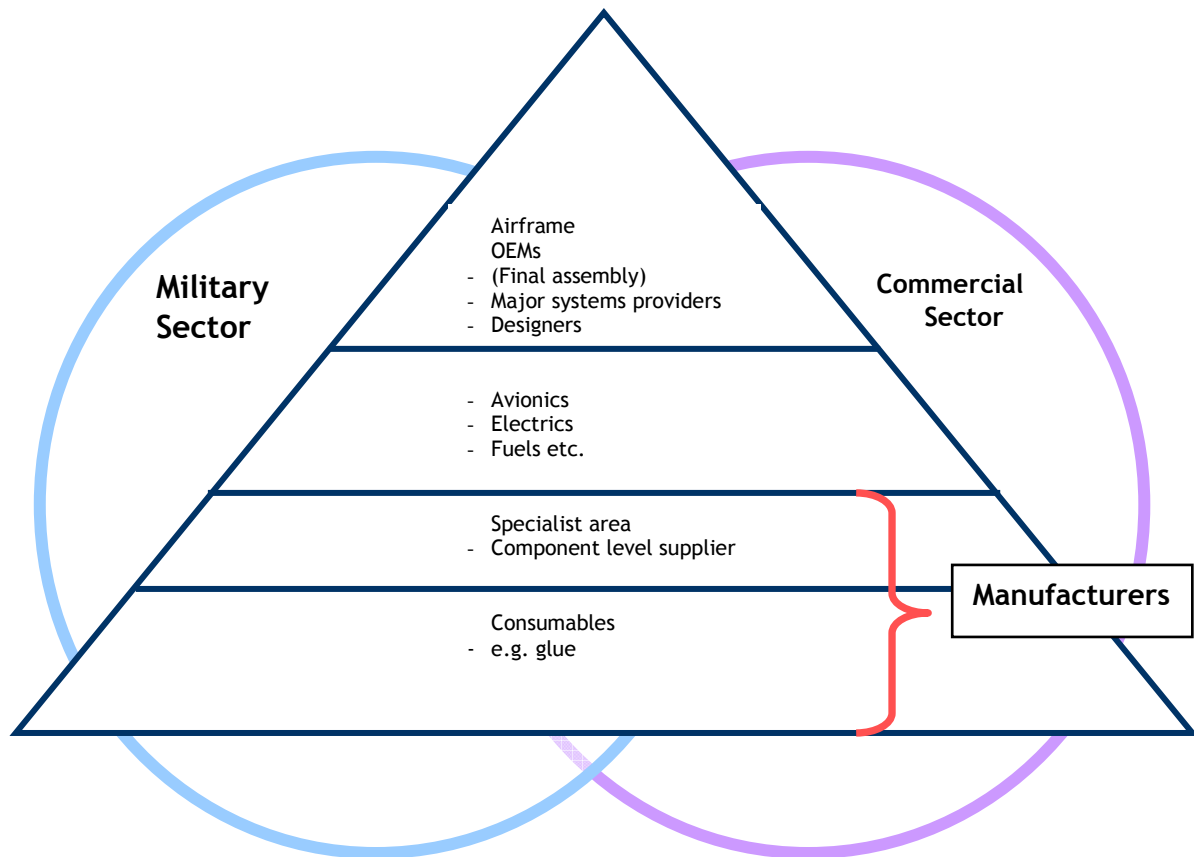


Figure 14: Diagram demonstration of General Aerospace Industry Supply Chain

The game of the industry unfortunately, according to Dr. Crute is that many players must have a stake in the program and if one is not able to get in a program, then one is out of the game. This is true for the higher end of the triangle (figure 13), but it is not all such a pessimistic view. Companies like Avionic Services who are operating in the equipment sector providing products to the bigger players may be a possible potential sector for Eatec to develop as there are more companies further down the aerospace chain to target and perhaps Companies as such will require specialised services to assist with contracted work from a part of a big program.

Market Research: The Aerospace Industry

5. Conclusions

The UK aerospace industry and space industry was described. Although the report does not represent the position of any individual company, it does attempt to reflect a general assessment of the UK aerospace and space industry to assist with Eatec's strategic planning process.

It goes without saying that the terrorist attacks of 11th September 2001 triggered a chain of circumstances that had a great effect on the aerospace industry. An equivalent of approximately 10% of the total UK workforce was lost in the UK's prime manufacturers and the first tier of suppliers in the supply chain.

It seems that partnerships between the manufacturers, operators, unions and UK Government is identified as essential to help the UK Aerospace Industry get through the aftermath of last year's crisis. Although it was argued that Government support for aerospace research and technology development has declined significantly over the past 15 years, it remains an area where the UK claims to have retained technological and manufacturing capability to add value in the global production system and supply chain.

The performance of aircraft and equipment is a key discipline of aeronautical engineering and industry standards and specifications and therefore, developing new research solutions for greater efficiency is what many research centres are set up to do and to develop industry credibility. From the general assessment, research activities are still going strong and more pressure and responsibilities are being placed further down the supply chain. Since skills and techniques can be adapted easily into the automotive industry, it would make this industry more attractive to concentrate on in conjunction with the aerospace industry and it is inevitable that new research and engineering solutions are welcome in this highly technical industry. Engineering remains a demand for the industry and if there is a lack of future Engineering Graduates being attracted to the market, it is possible services like Eatec will be contracted less reluctantly to assist with the demands filtered from the top tier. Eatec could consider entering this market in the third tier level to develop industry credibility before heading for bigger aerospace programmes.

Market Research: The Aerospace Industry

As a next step, it would be useful to try and understand a little more about the consultancy side of the industry. Within the report, we were briefly told that project is contracted out mainly for basic routine work only and to assist with work demand at a particularly busy time. The questions we need to ask now is:

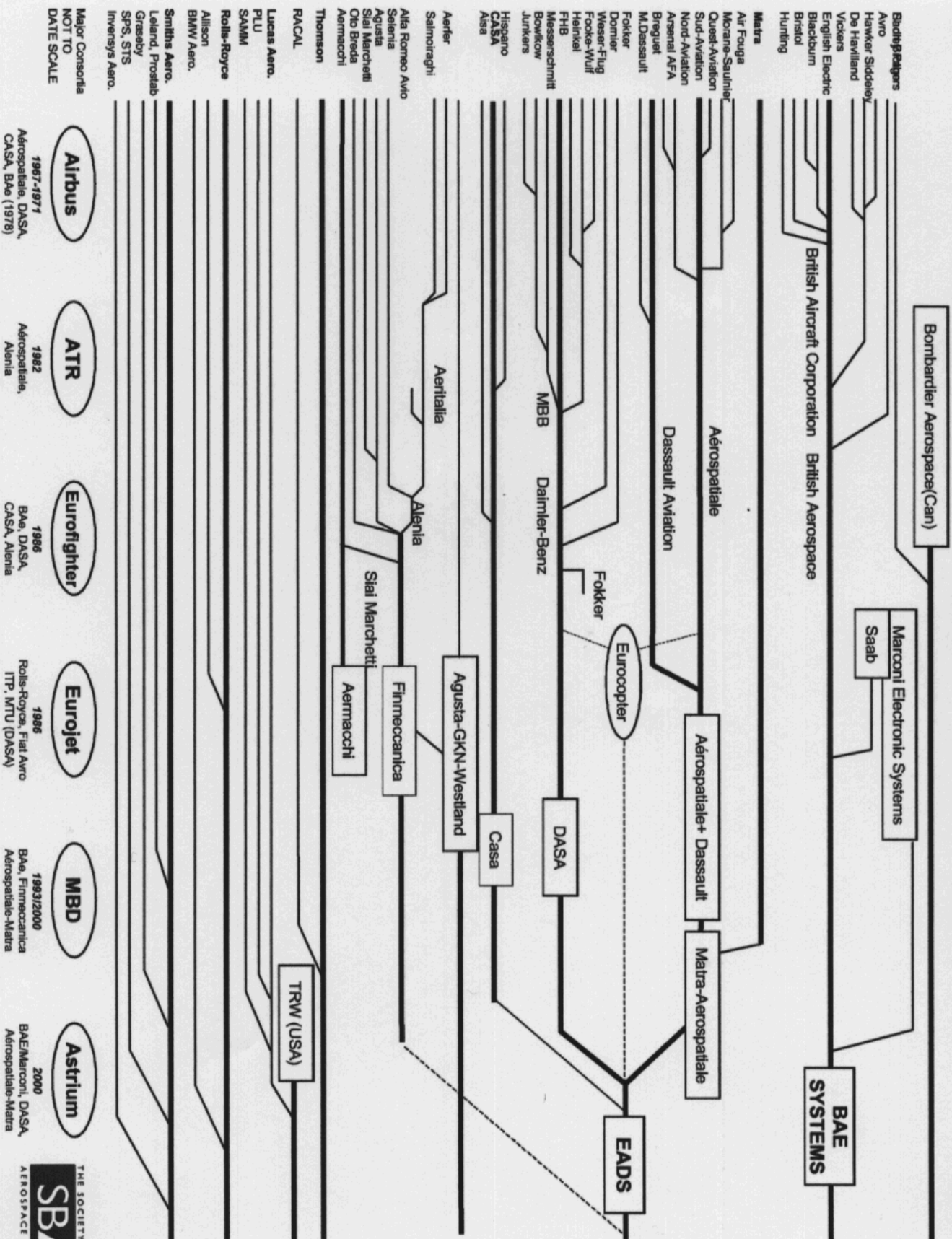
- How are mechanical engineering consultancies used in the industry?
- Who are the mechanical engineering consultancies of the industry?
- What do they do?

Appendix 1:

Source- A.T.Kearny and SBAC:

<http://www.sbac.co.uk/pdfs/a3xxbristol.pdf>

to > 1993 > 1995 > 1997 > 2000



Market Research: The Aerospace Industry

References

Contacts:

Dr. Valerie Crute, Research Fellow. UK Lean Aerospace Initiative (UK LAI)- 01225 384731. mnsvcc@management.bath.ac.uk

Mr. Rob Davies, Professional Engineer, future project team. Western Aerospace Centre (IMechE)- 0177 936 3981

Dr. Gary Lock, Course tutor aerospace engineering, University of Bath. Mechanical Engineering. 01225 826854. G.D.Lock@bath.ac.uk

Gareth Evans, TCS Associate. Avionic Services Plc (UK). garethe@avionicservices.co.uk

Articles:

The Society of British Aerospace Companies - <http://www.sbac.co.uk/>

DTI Report July 2001- British National Space Centre:
<http://www.bnsc.gov.uk/index.cfm?fast=evalfund1>

Logica UK- <http://www3.logica.com/papers/ukspace/ukspace.html>

<http://www.ukspace.com>

Defence and Peace Economics. *Globalisation in the Defence Industry: An Exploration of the Paradigm for US and European Defence Firms and the Implications for being global players*. Neal, Derrick J.; Taylor, Trevor. 2001, Vol. 12 Issue 4, p337, 24p, 6 charts, 2 diagrams.

PHD Thesis- *An attribute management process to enhance concurrent engineering in the aerospace industry*. Ian Chatting. Thesis (Ph.D.) - University of Bath, 2001

Market Research: The Aerospace Industry

MSC. Thesis- *Object-oriented design of a civil jet aircraft*. Peter Timling. Thesis (M.Sc. in Aerospace Engineering) - University of Bath, 2000

BBC News- *Aerospace firm upbeat despite sales fall*. Friday, 17 May, 2002.
http://news.bbc.co.uk/hi/english/business/newsid_1993000/1993446.stm

BBC News- *New partnership for Airbus industry*. Friday, 8 February, 2002.
http://news.bbc.co.uk/hi/english/uk/wales/newsid_1809000/1809061.stm

UK Government: *Wilson welcomes positive news for UK aerospace industry*. 5 July, 2002. <http://ehostvgw18.epnet.com>

International Journal of Small Satellite Engineering. *Satellite Design: Past, Present and Future*. Cyrus D. Jilla, Dr. David W. Miller. 12 February 1997.
<http://www.ee.surrey.ac.uk>

Koza, N. (1999) *When to Choose an Acquisition or Strategic Alliance*. Cranfield Alumni Lifetime Learning Conference, Cranfield University. November.

Airbus UK- <http://www.airbus.com>

BAE Systems- <http://www.baesystems.com>

Morring JR, Frank. Washington. Aviation Week & Space Technology. *NASA Adapts CFD For Earth Science Data*. August 6, 2001.

Barrie, Douglas. London. Aviation Week & Space Technology. *Technology Base 'At Risk' in UK*. March 18, 2002.

Cranfield Aerospace Ltd- <http://www.cranfield.ac.uk>

Vibro-Acoustic Sciences Newsletter. Vol. 4 No. 1.
<http://www.vasci.com/company/events.html>

Market Research: The Aerospace Industry

Barrie, Douglas. London. Aviation Week & Space Technology. *U.K Aerospace Pummelled By Commercial Downturn*. February 4, 2002.

Mills, B. (1995) *The Role of Information Technology in Cross Functional Integration*. PHD Thesis, University of the West of England.

Velocci, A. (1998) *Aviation Week and Space Technology*, May 11.

Velocci, A. (1998) *More Rigorous Methodology Applied to Gauge Competitiveness*, Aviation Week & Space Technology. August 10.

Goldberg, G. (1999) *Aerospace Expo 98, Conference wrap up*. Aviation Week and Space Technology, February 15.

Hammer M, Champy J. (1995). *Re-Engineering The Corporation*.

The Automotive Industry Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

Market Research: The Automotive Industry

Contents

1.	Introduction- General Background of the Automotive Industry in UK	3
2.	How are Engineering Techniques being used in the Industry?	5
2.1	The Advanced Technology Group (ATG)	5
2.2	Ford Motor Company	7
2.3	ArvinMeritor	10
2.4	CAE of Aluminium Road Wheels	12
2.5	Valeo Wiper Systems (VWS)	10
2.6	The World of Motorsports	12
3.	What engineering services are companies offering to the automotive industry?	15
4.	Is Engineering outsourced?	17
5.	Conclusions	18
	References	19
	Appendix- Attached separately to document	21
	(Due the extent of these documents, these are not included within the appendix of this thesis. These documents remain at Eatec Ltd premises)	
	- The Society of Motor Manufacturers and Traders November 2001	
	- UK Automotive The Total Package	
	- Vehicle Production in the UK	
	- Automotive UK: key facts on the automotive sector (DTI)	
	- Automotive Design Engineering in Britain (DTI)	
	- Britain's Total Automotive Package: from concept to sales (DTI)	

Market Research: The Automotive Industry

- Has Engineering outsourcing gone too far? Ward's Auto World

1. Introduction- General Background of the Automotive Industry in UK

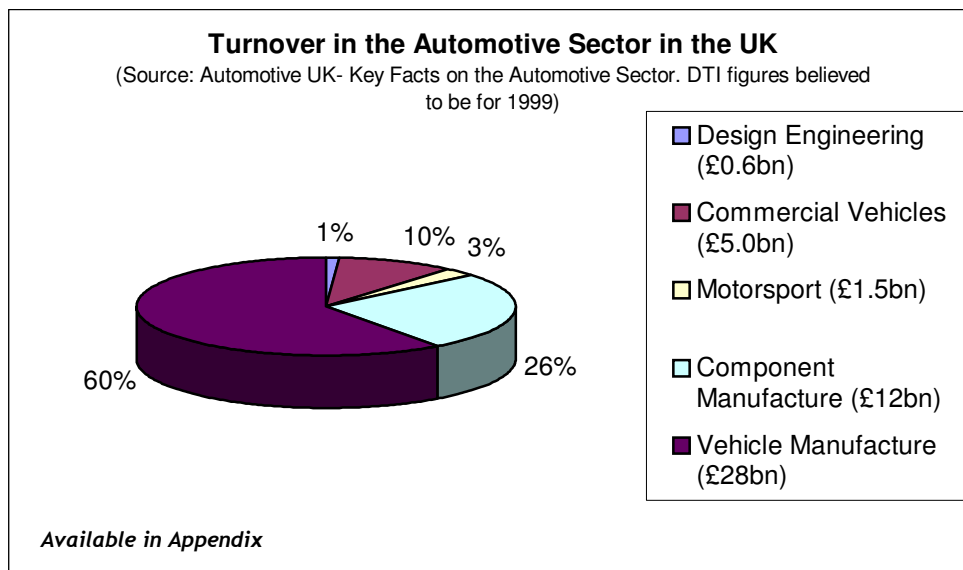
The UK automotive industry employs around 850,000 people and is worth approximately £47 billion, representing 8% of the global industry size (Trade Partners UK, 2002). The world's leading vehicle and automotive component companies have long seen the UK as being an important location for manufacturing. US-owned Ford first established a plant here in 1911 and today it has been joined by General Motors (GM), BMW, Honda, Nissan, Peugeot and Toyota, all of whom assemble cars in Britain. In total there are now 40 production plants in the UK. Ford, GM, Rover, Toyota and BMW also produce automotive engines in the UK (Ian Wagstaff, Automotive Directorate, 2001). There are in addition about 7,000 automotive component suppliers manufacturing in the UK, including such leading global players as Delphi, Bosch, Visteon, Federal-Mogul, and TRW (Department of Trade and Industry, 2001).

The Industry is structured where the first tier¹ suppliers operate at the complete system or module level, and become responsible for the interface with second and third tier component suppliers. The UK sector is notable for having a large number of small companies (SMEs). In some cases these are actually owned by large companies for which automotive activities is only part of their industrial portfolio; in other cases they offer extremely high, if not unique levels of expertise in specialised areas of vehicle technology (http://www.autoindustry.co.uk/companies/total_package [Accessed on 07/03/2002]).

The UK is one of the five major automotive manufacturing countries in Europe, of which £28 billion is accounted for by the vehicle manufacturers, £12 billion by the component manufacturers and £5 billion by the commercial vehicle manufacturers. The rest is in the design, engineering and motorsport sectors. The UK also has a very strong automotive aftermarket worth around £5 billion (The Society of Motor Manufacturers and Traders- SMMT Nov. 2001).

¹ **Global Tier 1s**- including the world's three largest- Delphi Automotive Systems, Robert Bosch and Visteon. **Local Tier 1s**- supplying value-added sub-systems or assemblies. **Local Tier 2s**- supplying component parts. **Global Tier 3s**- e.g. major raw materials suppliers supplying chemicals, metals etc. **Local Tier 3s**- e.g. machine shops, components etc.

Market Research: The Automotive Industry



However, it is in the field of motorsport where the UK automotive industry obtains the most skills. Throughout the 1980s and 1990s the Formula One World Championship has always been won by the driver of a British-built car with the previous two decades also seeing a rarely beaten dominance (Ian Wagstaff, 2001). The world's motorsport teams nearly all look to the UK for their expertise. According to the authoritative "Britain's Winning Formula" by Martin Beck-Burridge and Jenny Walton, "almost all of the world's premier automobile manufacturers from the USA, Italy, Germany, France and Japan draw upon UK technical and engineering expertise in this field (Automotive UK, February 2001). The UK motorsports industry has an estimated £1.5 billion turnover with an export total of around 44%.

The UK has a global reputation for offering excellence in automotive research and development, from concept to engineering and production. The appendix (Vehicle production in the UK- attached separately) shows all the companies who operate production and assembly facilities in the UK. Some of these companies that we are more familiar with are: Bosch, Du Pont, Goodyear, Hitachi, Pilkington, Siemens and Unipart. A list of design engineering technical centres is also available in the appendix.

Market Research: The Automotive Industry

As a summary to the introduction, the UK motor industry is host to most of the world's leading vehicle manufacturers, is a world leader in motorsport design, development and manufacture and most important of all has a major design-engineering sector.

2. How are Engineering Techniques being used in the Industry?

Motor manufacturers across the world will always need technological help and support to ensure success. A major element of that support is coming from Britain in the form of design engineering. Design engineering input by specialist, focused companies, has become a central part of almost every new vehicle programme launched by original equipment manufacturers (OEMs), and of major supplier projects (Automotive Directorate, 2001).

The best way of demonstrating how the automotive industry is using new technologies is by drawing up mini case studies.

2.1 The Advanced Technology Group (ATG)

Design, test and analysis work together in the automotive industry to meet the growing demands for higher quality vehicles, shorter lead times and reduced costs. One of the crucial advantages for world players in coming to the UK for suppliers, or with investments, is that there are companies with specialisation in all these areas-independently or together (Automotive Directorate, 2001).

ATG is part of Ove Arup & Partners international civil engineering consultancy. ATG operates in Coventry in the West Midlands, London and Detroit in the US and works extensively with automotive OEMs that include Ford, GM, Rolls-Royce, Daewoo, DaimlerChrysler and the former Rover Group and Tier 1 and tier 2 suppliers such as Johnson Controls and Lear Seating (Total Automotive Package, 2001). They utilise their expertise in stiffness, strength, durability, noise and vibration and crashworthiness to

Market Research: The Automotive Industry

optimise vehicles and components in their design stage using computer-based modelling and simulation techniques.

Engineering technology allows vehicle makers and suppliers to identify and resolve problems through design changes, and before expensive prototypes are built. Neil Ridley, the Associate Director of ATG says that there is an increasing focus on crash-worthiness and noise, vibration and harshness (NVH) prediction in the automotive industry to predict and improve the performance of vehicles in line with rising consumer expectations and legislative requirements.

For example, in Crashworthiness Analysis, computer simulation is used to develop and test proposed designs before the design is fixed and before expensive prototypes are built and crashed, creating opportunities to change and improve designs at an early stage. In Durability analysis and testing, computer simulation is used to produce dynamic analysis model to identify components in which fatigue problems are likely to occur. Eliminating fatigue problems at an early stage in the design cycle helps to reduce the time to market. This is an essential part of the vehicle design development to meet public demand for a reliable car. This results in engineers working under intense pressure to optimise the performance of products, reduce costs and reduce the time to market.

Ridley says: “These demands mean there is a much greater focus on using analysis to lead the design process in order to ensure specifications or requirements are met from an early stage, avoiding costly redesign later and minimising some of the prototype testing, which costs between £100,000 - £200,000 per vehicle.” (Total Automotive Package, 2001²). Computer simulation has been an enormous boon to the automotive industry. Together with other advanced design, development and production techniques, CAD (Computer aided design) and CAE (Computer aided engineering) have helped the industry to reduce the time from vehicle concept to production from about five years to only three years (ATG, 2001).

² Department of Trade and Industry, Automotive Directorate. *Britain's Total Automotive Package- from concept to sales. An Executive Briefing* p54. *Case Study, Design First, Test Second.*

Market Research: The Automotive Industry

2.2 Ford Motor Company

Ford works to a C3P strategy for CAD design and data management (Alec Pumford, Ex CAD designer for Ford Motor Company, 2002).

C3P stands for:

- CAD (computer aided design)
- CAE (computer aided engineering)
- CAM (computer aided manufacture) &
- PIM (product information management)

i.e. C,C,C,P or C3P.

These four elements describe the four main uses for Computer Based Engineering in the automotive industry in their most basic forms.

Computer aided design is split into solid modelling, and surfacing software. Both produce the same results but in slightly different ways for slightly different uses. Specialist surfacing software is usually employed to create the smooth class "A" surfaces that form the skin of a cars bodyshell. Solid modelling software is more about encompassing and is used to create everything else.

Computer aided engineering software is used to assess the models created by the computer aided design software. The assessment is usually carried out using FMEA (Finite Material Element Analysis to test the materials but acronym also known as Failure Modes & Effects Analysis), which is a method of calculating loading, heat expansions, and stress on parts. Although impact testing and dynamic testing is also used to test the engine wear but FEA is a standard, which covers all the required assessment. After the components have been assessed they are then passed onto the CAM engineers who eventually manufacture the parts.

Market Research: The Automotive Industry

Computer aided manufacture takes the information created by Computer Aided design software and uses it to create virtual tools so that simulation work and loading can be tested (using FMEA again) and are eventually used to in manufacturing.

Product information management describes the system used to control the flow of information between the three systems above and the various departments within each grouping using each system. PIM software is usually part of the CAD software and usually relies on communication between separate servers, which contain various libraries of information, which are updated regularly and collected together into one central source, which everyone can view but only CAD data-coordinators can control.

Ford like many other large organisations in the engineering industry contracted out work to agencies working in-house as well as to outside suppliers. The work that is mainly outsourced is the leg work of a programme, such as the preparation of the design or model for testing, generating the model and converting the CAD geometry to a mathematical representation which can then be used for FEA, and sometimes testing is also carried out on behalf of Ford. Ford then analyses the information received, and perhaps make some alterations and then agreement. This is to avoid absorbing all the internal specialist staff but sensitive information is not outsourced to avoid giving away trade secrets.

Alec worked as a data coordinator for one of the diesel engines for the new Focus coming out in 2004 and many of the people he was dealing with were not within the Ford organisation but were contractors working on the project through other companies for Ford. CAE was also dealt with in the same way with Ford asking outside suppliers to tender for work on current and future projects within each department.

Alec was not privy to the information regarding cost of sourcing external engineering consultancies but they were charging for the man and machine hours rather than just the man hours on the project.

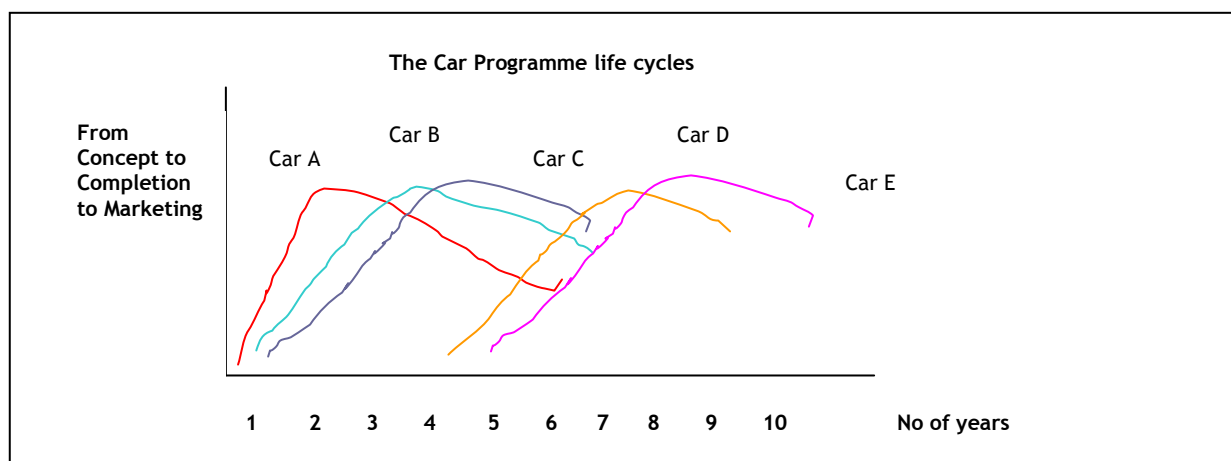
Alec stated that the use of simulation and prediction work in tier 1 and 2 suppliers is used as much as manufacture is required from concept to completion of the programme.

Market Research: The Automotive Industry

Everything that is designed carries out as much simulation work as much as possible before building and testing the model. Although the manufacturers do not insist that tier 1 and 1 suppliers have to use analysis techniques, it's become an expected industry standard.

Ford Motor Company realises the benefits of using high-performance computers in diverse CAE and CAD. By displaying CAR/CAD data as realistic three-dimensional objects, researchers hope to dramatically reduce the time required to construct, modify, and evaluate design concepts. In one case (a styled wheel), Ford scientists have cut the process from 24 days to 16; in another (a control arm), they reduced the process from 33 to 15 days. In both cases, the use of high-performance computers and advanced software permitted the scientists to provide more accurate simulations (Mathematics and computing science division, Stevens 1994).

It is a huge market with lots of potential. It is at the moment slightly unstable due to the economic climate (Pumford, 2002), and there is not either a growing or declining number of tier 1 & 2 suppliers in the UK but remains static with respect to design and development rather than manufacturing. The programmes usually run in a five-year cycle, where 3 -4 vehicles may be started up at the same time and at the time to market, a preparation of a new programme may be started up. Therefore, fluctuation of workload can occur at certain time of the life cycle.



It was recommended that should one wish to enter this market, one should try and pitch for work from one of the suppliers or sub-suppliers of the big players like Ford, or Jaguar

Market Research: The Automotive Industry

etc. in order to find their feet first and become established before trying to compete on a level playing field with the leading companies in this market like MSX and Visteon for example.

2.3 ArvinMeritor

ArvinMeritor deliver advanced technological solutions for light vehicle, commercial truck, trailer and specialty original equipment manufacturers (OEMs) and related aftermarkets. They also make automotive exhaust systems and in this area, Ian Rutherford was interviewed who is the manager of a department that carries out FEA work for tier one suppliers.

With regards to how extensive is the use of simulation and prediction work in tier 1 & 2 suppliers, Ian stated that this depends on different area, but predictive techniques are expected to be used as much as possible wherever possible, and mainly to reduce development time. Although in Ian's work area, FEA is mainly used, the other main kinds of techniques widely used in the company include CFD, emission simulation where they have developed their own software in house and also thermo stress analysis. The trend to use these techniques is not increasing or decreasing but it is an expected standard practice to use predictive software.

Ian stated that most tier 1 and 2 suppliers prefer not to outsource projects in case of letting out trade secrets apart from perhaps the standard analysis work. The average consultancy fee charged depends on the level of engineering but it ranges from £35 hr - £50 hr. Apart from minimising the amount of outsourcing where possible, there is also pressure to reduce the number of suppliers, as it is believed this will be better for management. OEMs are also under pressure to restrict the number of suppliers. But there is a growing trend and that is tier 1 suppliers having to grow faster internally or by developing joint ventures. This is to gain global position as most automotive companies work on a global basis, and where the customer is, the company has to be in. This is not just manufacturing but also Research and Development.

Market Research: The Automotive Industry

The findings from this case study reinforces the findings in the Ford Motor Company case and concludes that although it is not insisted by manufactures that tier 1 & 2 suppliers use analysis techniques for simulation and prediction assessment but it is expected to be used in the automotive industry but as part of the process. It is applied to reduce development time, but this does not rule out that testing is still required to confirm the assessment.

Companies are also getting bigger by joining together and therefore, there are less companies but stronger players in the market.

2.4 CAE of Aluminium Road Wheels

Today computer based styling and simulation of wheels prior to the production process plays an essential role in the design, in order to address fast changing styling trends and the cost of production. CAROW has been funded by the European Commission within the HPCN TTN³ network to assess and disseminate the implementation of simulation technologies in the wheel industry.

High Performance Computer technology and applications have been used through the whole cycle of the design, casting and investigation of mechanical behaviour to create accurate and realistic 3D models of cast aluminium road wheels (Carow, 2000). The CAROW project investigated the relevant aspects of simulations in the wheel manufacturing process including:

- CAD and visualisation for the design process
- FEM to predict the mechanical properties of the wheels
- CFD for the simulation of the casting process

The mechanical behaviour of wheels during the lifetime of a vehicle is of highest importance due to safety reasons. The goal for CAROW was to show Alloy Wheels International Ltd (AWI) in Kent that it is possible to use simulation to examine the

³ High Performance Computing and Networking Technology Transfer Nodes

Market Research: The Automotive Industry

structural properties of a rim without having to produce a prototype first. The main result was the identification of crack locations by the evaluation of plastic strains beyond critical strain values, which proved high correlation in comparison with the results of tests made with the real wheel. Roland Mortier of AWI sees that the competent use of FEA technology has significant effects on company costs which may be summarised with a simple equation: FEA=Design right first time. Mortier has summarised benefits in three areas: development benefits through cost and time reduction in tooling, manufacture, testing and design. The use of simulation helps produce lighter wheels meeting the same requirements. The reduction in material reduces the costs and the reduced weight of the wheel leads to reduction in fuel consumption. AWIs' project planning has become a more linear sequence of predictable events rather than a rushed convoluted set of redesign and test loops, thus making management of new products much easier (R.Mortier, AWI).

To conclude from this case, CAD, FEM and CFD have made a positive impact on the manufacturing conditions and product quality in Road Wheels.

2.5 Valeo Wiper Systems (VWS)

VWS is a Tier 1 supplier to automotive manufacturers. One area where CFD has been applied is a program to minimise the uplift of wiper blades on cars travelling at high speeds. In the past, Valeo engineers have relied on experimental prototypes to bring about performance improvements in their products, but increased time demands on the delivery of new products to their customers have made alternative testing methods necessary. Due to this reason, VWS has turned to CFD analysis as a primary component of their design process (Fluent Newsletter Supplement, Focus on CFD. Fall 2001).

2.6 The World of Motorsports

The UK has evolved in the last decade as a world centre of motorsport and high performance engineering and next generation technology for the development of

Market Research: The Automotive Industry

modern road vehicles. UK motorsport firms are based in an area known worldwide as 'Motorsport Valley' in southern and central England where most specialist motorsport firms have their research, design engineering and production facilities. They supply the cutting edge technology used in Formula 1 and dominate the production of cars and components to champ cars and other top racing formulae in the US (The Motorsport Industry Association, 2002).

Approximately 4,000 companies are involved in the UK motorsport manufacturing industry and its wide-ranging support activities. The engineering part of the business has an annual turnover of £2.9 billion (The Motorsports Industry Association ⁴), over half of which is exported.

Motorsport Valley is renowned throughout the automotive industry. The major car manufacturers have fully realised the value of being associated with the global popularity of motorsport in all its forms, and the transfer of its advanced technology into the mainstream automotive industry.

CAD has replaced the typical drawing board in F1 design during the last 20 years. The designers can visualise how the parts fit together much easier than trying to interpret 2D drawings on paper. CAD software can be linked to FEA software and helps the F1 engineer to calculate the stress and strain build up in each part of the component, with varying degrees of stress being depicted by various colours. The designer can then make the necessary changes to the design where for example a higher stress in one area may be redirected to another area.

Due to the high speeds reached in F1 today, one of the main design areas of the car is aerodynamics. As well as using FEA, the F1 team uses CFD to analyse external body parts, which helps to predict how the airflow will behave around the part. This kind of software is used in parallel with the wind tunnel⁵ to evaluate the efficiency of aerodynamic parts such as front wing arrangements and diffuser layouts. This is

⁴ The Motorsports Industry Association- http://www.the-mia.co.uk/new_design/site/printdoc.cfm?section=5&page=79 [Accessed on 21/03/2002]

⁵ The Wind Tunnel is usually a half scale facility as a full scale one would be far too expensive and time consuming. The road speed is synchronised with the air speed in the wind tunnel to ensure that the under body aerodynamics' of the model behave as those on the car will do on the track (Andy Marson, 2001)

Market Research: The Automotive Industry

extremely useful for the motorsport industry because wind tunnel work can only provide the raw data, whereas CFD software gives a picture of how the airflow moves over the car, and designers can use it to see how they can direct more air to the rear wing for example (Andy Marson, 2001). Although CFD is a good tool for F1 to predict aerodynamic performance, for instance, it can only be seen as a complementary tool. Prototyping and wind tunnel test still needs to be carried out.

However, Britain's dominance in engineering and technology in the F1 motor racing industry is under threat from a powerful challenge by Germany (John Griffiths, FT March 2002) caused by Toyota's recent decision to invest nearly £700 million in it's F1 operations in Germany and BMW, technology partner to the Oxfordshire based Williams F1 team, undertakes all the team's engine developments in Germany. The same goes for a number of world rally championship teams and enterprises.

However, The Motorsports Industry Association has joined force with the Department of Trade and Industry and four regional development agencies in a £10million project to strengthen its infrastructure. The plan is for UK motor racing to have its own institute of technology in collaboration with Oxford Brookes University and the institute will build on innovative engineering courses devoted to motor sport but the industry will need to come up with £3 million by the end of the April 2002 to match the DTI's own planned investment.

Despite these challenges, engineering services is a hot spot for the industry so watch this space.

3. What engineering services are companies offering to the automotive industry?

Hawtal Whiting is a highly respected automotive design business based in the United States and UK, and in October 2000 it became part of the Wagon group (wagon-plc.com, Issue 4. November 2000). Hawtal Whiting's major customers include Ford Motor Company and General Motors. The Company is a comprehensive design engineering service and has ISO 9001 Quality Accreditation and Ford Q1 Supplier Status. The service they offer to the industry includes animation, graphic design, inter-active electronic media and visualisation techniques, which are important aspects of design. In engineering analysis, the capabilities they have include structural stiffness, durability, impact performance, occupant protection, noise prediction and suspension behaviour.

One aspect of a whole vehicle project is the powertrain- engine, gearbox and transmission. Any engine must operate at very high and very low temperatures, necessitating climatic testing; it must have the latest type of engine systems, it must meet emissions regulations and it must meet all quality requirements. Britain's design engineering consultancies can meet such challenges using CAD and engineering and testing of prototypes and pre-production units in fully instrumented test cells (Automotive Directorate, Feb 2000).

MIRA is the longest established design-engineering organisation in the UK and provides CFD expertise, noise, vibration and harshness (NVH), safety engineering to name just a few.

MSX is also a leading global provider of technology-driven business, engineering and specialised staffing services. The Company's CAE/CAM service enables them to undertake engineering analysis of a variety of problems, with particular emphasis on impact behaviour and the reduction of noise and vibration.

NEL (National Engineering Laboratory) is one of Europe's leading engineering technology services. Their services include engine mathematical modelling design and analysis,

Market Research: The Automotive Industry

finite element analysis of components and larger structures, gearbox prototyping and development, reduction of NVH, crashworthiness evaluation, steering systems analysis, risk assessment and failure mode and effect analysis.

Perkins technological input into major programmes is significant, including NVH, CFD port development, exhaust gas recirculation and combustion, exhaust particulate size measurement, and engine wear studies using thin layer activation and CAE.

4. Is Engineering outsourced?

As the Ford case suggested, many organisations outsource their work as well as managing in house. In an engineering survey (Ward's Auto World, Mar 2001⁶), most OEM respondents (73%) say their companies will outsource more engineering work in the next five years, compared to only 44% for suppliers. The problem that most companies face is that by outsourcing, technical expertise is being exported which presents problems in the long run and also a potential for letting out trade secrets.

At first instance, these findings seem to conflict with the findings from the telephone interviews earlier because the tier 1 and 2 suppliers, such as Ian Rutherford from ArvinMeritor stated that it is preferred that engineering work is not outsourced, but further down the Ward's Auto World Survey, states that, "A supplier respondent suggests that partsmakers also are looking for engineering houses or lower-tier suppliers to take over this engineering work." And "This passing of the engineering buck creates the impression that no one really wants to handle the down-and-dirty work of product development and testing, that there's always someone one floor lower ready for the job."

This suggests that companies are still outsourcing engineering work as suggested by the Ward's Auto World Survey. The kind of outsourced engineering work is the legwork, the standard analysis testing (as Alec Pumford suggested in the Ford Company Case), or as the respondent's of the survey puts it, '...the down-and-dirty work of product development and testing...'. If it is anything high level or secretive and unique to the programme, then of course outsourcing would be inappropriate.

⁶ Available in Appendix

5. Conclusions

Critical to the success of an automotive company is its design and development process. In an industry that is market driven, automotive industry is faced with more demanding performance and design targets than ever before. These are particularly in the area of shortening design times through optimised virtual design processes, implementing stylish automotive shapes with good aerodynamic characteristics, and enhancing driving comfort via reduction of noise.

Analysis techniques are now very much a design tool embedded within in house design processes at all major automotive manufacturers and their suppliers. The report has only outlined some of the uses for engineering analysis techniques in the automotive industry but the techniques can be applied to many products to improve performance.

Generally, it is the more routine work which is outsourced, with the novel and research based work being kept in-house. It is certainly not a shrinking area and there is a market where Eatec can apply its services and starting from simple testing work is perhaps a way of gaining industry trust.

Market Research: The Automotive Industry

References

Alec Pumford, Former Ford Employee. 01639 852502

John Bamfrough, Optimat Ltd. 01355 272800

Ian Rutherford, ArvinMeritor. 01772 679999

Dr Tony A R Mileham, Mechanical Engineering. University of Bath ensarm@bath.ac.uk

Tony Webster, The Motorsport Industry Association 024 7669 2600

Wagstaff, Ian. *Automotive UK, Key facts on the Automotive Sector*. Automotive Directorate, Department of Trade and Industry, February 2001.

Birch, Stuart. *Automotive Design Engineering in Britain*. Automotive Directorate, Department of Trade and Industry, February 2000

McCann, Tom., Bakke, Colin. and Stent, Jackie. *Britain's Total Automotive Package- from concept to sales. An Executive Briefing*. Automotive Directorate, Department of Trade and Industry. Channel Publications, 2001

Hargreaves, Ben. *Keeping it real*. Engineering. Gillard Welch Limited. Vol 243 No. 3. pg. 53-56. March 2002.

Auto Industry- about the total package programme. [web assessed on March 2002]
http://www.autoindustry.co.uk/companies/total_package

Bamfrough, John. *Optimat Ltd sponsored by DTI and SMMT*. August 2000

Murphy, Tom. *Has engineering outsourcing gone too far?* Automobile industry and trade. Ward's Auto World, Vol. 37 Issue 3, p71. March 2001

Market Research: The Automotive Industry

Automotive Industries. Trade Partners UK. [web assessed on March 2002]

<http://www.tradepartners.gov.uk/automotive>

Marson, Andy. *F1Mech.com*. 1998-2002

Griffiths, John. *Britain's F1 industry spots Germany in slipstream*. Financial Times. 15th March 2002.

HPCN TTN network. *Computer Aided Engineering of Aluminium Road Wheels*. CAROW [web assessed on March 2002]

Stevens. *Automotive and Manufacturing Applications: Ford*. <http://www-fp.mcs.anl.gov/hpcc/>. [web assessed on March 2002]

Automotive Directorate. *The Automotive Industry in the United Kingdom*. November 2001

Fluent Newsletter Supplement. *Focus on CFD for the Automotive Industry*.

Mesaros, Lisa., Koucky, Sherri. *Tier One gives CFD a bigger role*. Machine Design. Vol. 72. Issue 2. pS72. 27th Jan 2000.

<http://www.wagon-plc.com>. Issue 4, November 2000

Appendix

The Consumer Goods Market

Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

Market Research: The Consumer Goods Market

Contents

1.	Introduction- A flavour of the sectors	3
1.1	The Consumer electronics market	
1.2	The Mature white goods market	
1.3	The Mobile Phone market	
2.	Managing design for a quality product	6
3.	Conclusions	11
	Appendix: Questionnaire	12
	References	15

Market Research: The Consumer Goods Market

1. Introduction- A flavour of the sectors

1.1 The Consumer electronics market

For practical reasons, research on the UK consumer goods sector has been reduced down to the consumer electronics market and the white goods sector only.

The UK consumer electronics market is worth approximately £4 billion annually, directly employing around 14,000 people. The main products manufactured by the UK are colour televisions (5 million were produced in 1998) and videocassette recorders (2.5 million in 1998), which represents nearly a third of Western Europe's entire output. Together these two products accounted for exports worth £4.95m in 1998. Audio units, hi-fi components and systems are also one of the UK's main products with approximately 2 million being manufactured in the UK in 1996. Activity is further increasing among UK based manufacturers as they begin to mass produce digital television products: both Set Top Boxes and integrated digital Television Receivers (idTV) and the dramatic (+299% in 1998) increase of UK sales of wide screen CTV to continue into 1999 are expected to continue. Nearly 75% of UK electronic consumer products are exported, mainly to Western, Central and Eastern Europe, North Africa and the Middle East, but in the case of audio products to the USA and Canada.

- Examples of electronic consumer goods:
 - CD players
 - radios, hi-fi
 - sound recording apparatus
 - televisions and videos
 - turntables

1.2 The white goods market

The white goods sector employs 20,000 people and has an annual turnover of £799 million, of which £173 million is exported. 30% of companies in this sector export, major destinations being Europe, North America, and Latin America. There has been significant success in attracting inward investment and increasingly

Market Research: The Consumer Goods Market

opportunities exist in niche markets (e.g. dehumidifiers) and for outward investors who are in a position to establish manufacturing in the world's new fast-growing markets. With the opening up of the UK gas market and development of gas fields overseas, there is also increased export scope for the UK domestic gas appliance sector (currently exporting just 1% of production), and growing potential for joint ventures/partnerships with overseas firms.

- Examples of household equipment:
 - household gas and electrical appliances (major appliances/white goods and small appliances)
 - cold appliances (fridges, freezers, etc.)
 - cooking appliances (gas and electric cookers, ovens, separate ovens and hobs, microwaves etc)
 - hardware
 - houseware
 - personal care (hairdryers, etc.)
 - small appliances (kettles, toasters, etc.)
 - wet appliances (washing machines, dishwashers, etc.)
 - other household equipment

1.3 The Mobile Phone market

Also part of the high technology goods but not defined in the consumer electronic sector is the Mobile Phone. The mobile phone market in the UK doubled in the year to February 2000, according to Continental Research, and by June 2000 had reached 50% of adults. The Big Three handset manufacturers continue to dominate mobile phone sales. Nokia, Motorola and Ericsson accounted for 53% of worldwide mobile phone sales during the second quarter of 2000. As the number of mobile connections continues to grow, the mobile phone market looks increasingly similar to that of any other established consumer electronics product. Although the take-up of internet-enabled Wireless Application Protocol (WAP) phones has so far proved disappointing, (WAP phones are now in 2% of Internet homes). They, and the third generation devices due to succeed them, are critical to the success of mobile (m)-commerce. Two million more Internet users claim an interest in

Market Research: The Consumer Goods Market

obtaining a WAP phone, according to NOP Research. And the uptake of text messaging (up from 15% to 20% of adults in one year) demonstrates that many UK consumers are willing to consider using mobile communications in innovative ways and are waiting for the right functionality at the right price.

Technology is advancing and changing at a rapid rate. Therefore, competitors are always finding better and faster ways of design and developing products at a less costly price. For example, James Dyson for Dyson's appliances has decided to move production of the vacuum cleaners to Malaysia where labour is cheaper so that more investment can be made in research and development in the UK. The decision to quit British production of vacuum cleaners can be seen as the result of a strong consumers awareness of quality and strong competition, and so many manufacturers have to look hard at how they can achieve that competitive edge that will keep them alive and hopefully take them into a leadership position. Sendo, Britain's mobile phone manufacturer has also expressed recently in the press that any fund raising they gain would finance research and development and expand its sales and marketing operations overseas.

So how does this affect the way Companies work?

Market Research: The Consumer Goods Market

2. Managing design for a quality product

Today, competition has driven organisations to consider concepts such as time compression (fast-to-market), concurrent engineering, leanness and technology. Derek Sheldon , Derek Sheldon & Associates (Design Engineering) expressed that it is essential to have in place communications and interactions with a wide variety of disciplines such as marketing, manufacturing, business planning, finance and servicing. All these functions play an important role in the activities of product delivery and have to work together and communicate effectively to bring quality to the process. And because fashion in the consumer goods industry change so quickly, it is essential to keep a lean process.

This ‘fashion’ seems to be reflected across the consumer goods industry. Advancements in engineering software development have played a major role in the redefinition of engineering processes and organisational structures. For many companies, the acquisition of new software technology and maintaining in house expertise often stimulates a rethinking of their overall design process, with the reward being an increased competitive advantage.

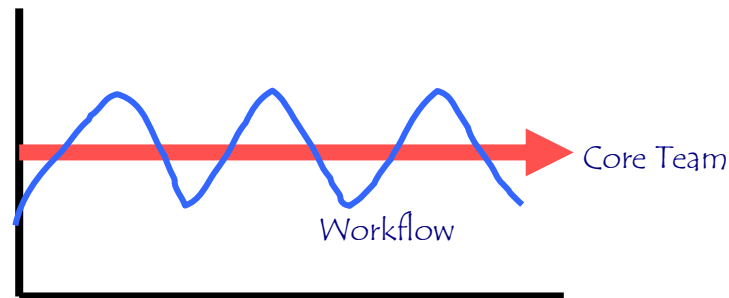
Take Dyson for example, the marketing team first looks at the trends in the market and develops a strategy.

The workload can usually be predicted so that work being filtered down the line does not get overloaded. Because of this, they usually do not outsource engineering consultants to be involved as they believe in keeping the knowledge in house. Then in the design process, appropriate in house expertise will be picked from a pool of knowledge to assist on a project. Dyson have 350 engineers and scientists including:

- New Idea developers
- Aerodynamicists
- Design engineers
- Laser Scientists
- Specialists in fluid mechanics
- Acoustic engineers
- Thermodynamicists
- Polymer engineers

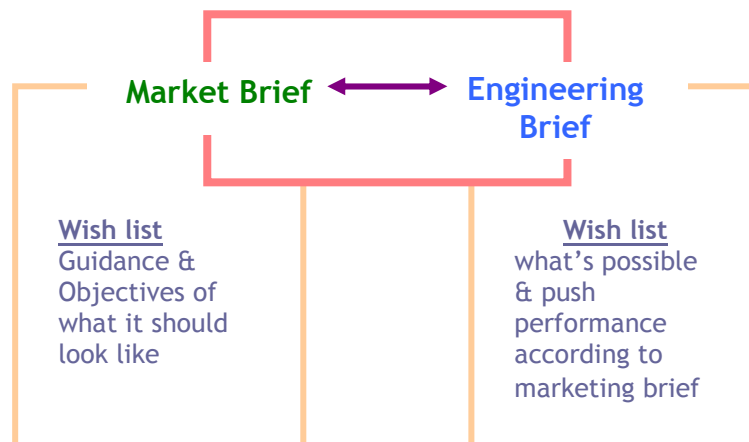
Market Research: The Consumer Goods Market

- Mechanical research engineers
- People with vision



A respondent at Dyson describes their workload as the graph above. Workload fluctuates but is generally spread evenly across the core team.

When interviewing respondents at Hoover, a similar ‘fashion’ was found. A project for a new machine is developed and two briefs are created as interpreted in the diagram below.



In response to the question regarding key design and engineering problems faced in designing a product, two briefs are created; a marketing brief and an engineering brief. The Marketing department would be concerned about meeting the objectives of what they want the product to achieve in appearance and the engineering department would be concerned about pushing the performance of the product to achieve the marketing departments brief. Therefore, engineering department in the research, design and development stage would solve any key problems relating

Market Research: The Consumer Goods Market

to engineering. And the marketing team would solve any key problems relating to appearance.

In response to 'any advanced engineering techniques used', initially the engineering team would create the 'skin' of how the product will look from a CAD file. Basic Stereo lithography Models are used throughout the concept phase of the new product development cycle. This is where much of the cost lies. The engineering team will then carry out a stress analysis on the product. And sometimes, FEA will be used but only to test the internal products of the whole products. This part of the testing comes before the complex mould is created but most of the work is spent on analysing the models. The aim is to create as less plastic as possible in the final moulding. Again little external resource is sought to assist in the research, design and development stage either because the company wants to maintain in house knowledge or that engineering consultancy techniques is provided in house or alternatively techniques are used which they feel are more cost effective and tests the brief more to their requirement.

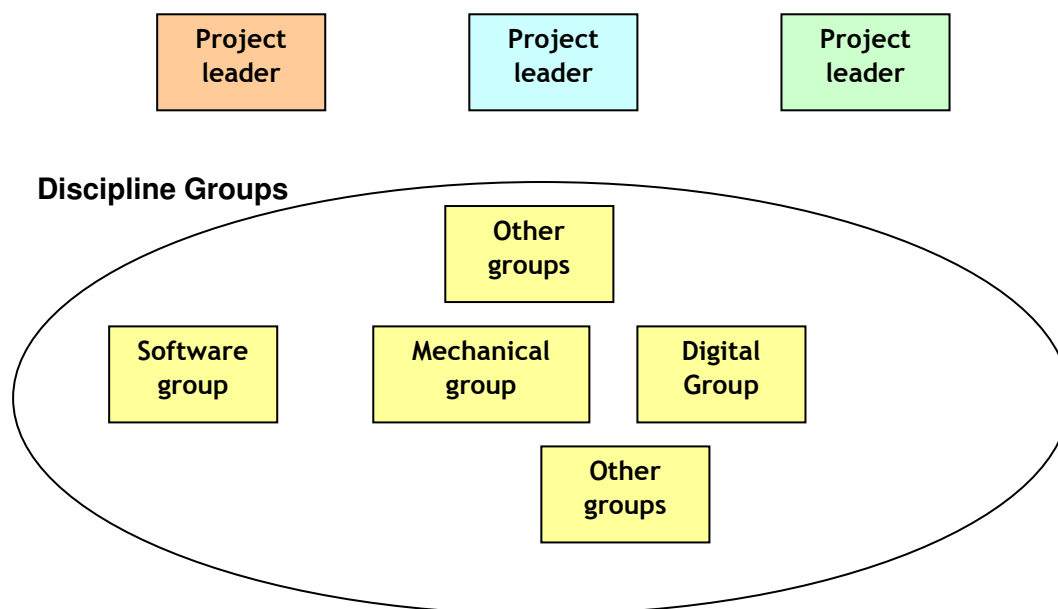
Another respondent at Hoover but based in a different design department expressed that a limited amount of CFD is used because they do not have a big enough team in house to perform such advanced techniques. To purchase skills externally in order to do predictions are too expensive and the profit margin gained from the products would out weigh the manufacturing costs if CFD was used during the research, design and development stage and would not be able to sustain the costs in the long run. That is why stereo lithography models are used as a prototype test. The respondent's past experiences was that the CFD service they paid for cost £6000 a week and since most engineering techniques are not able to give guaranteed results but predictions only, they have decided that it would not be required as a permanent strategy.

Hoover has the second biggest market share and possibly the only manufacturer left in UK following Dyson's announcement. Vax manufactures in China, Electrolux manufacture in Sweden and Goblin in Ireland. The makers of the vacuum cleaner, Henry is based in UK but they are very small and adopt a similar approach to research, design and development and adopting external engineering consultancy would not be practical. Electrolux and Vax have their own CFD research team and therefore would not benefit from external engineering resource. The only one scope which Hoover expressed would use external engineering experts is if the

Market Research: The Consumer Goods Market

engineering consultancy had the experience and knowledge of applying CFD across household appliances only.

Similarly, there are very few manufactures in the mobile phone industry based in the UK. Most bigger Companies are Ericsson, Nokia and Motorola. And a lot of the design phases do not take place in the UK. An engineering manager was interviewed at Motorola and the respondent expressed that the biggest part of the mobile phone which uses any engineering techniques are the electronics and software part of the phone. This part tends to use more Mathematical Modelling technique and FEA for the case design. The respondent indicated that it is more common for a Company to have their own pool of expert resource internally and then assign the appropriate experts for the project.



The project leader will then pick the right team of people for that project from the different discipline groups from the knowledge pool. In any case, external resource would not be sought for engineering consultancy.

The bigger mobile manufacturers will sell their phones to other smaller Companies and these phones are then 'badged' with the individual logos and it's own individual casing. What smaller companies usually adopt from external resource are fashion houses, one, which was given, was known as 'Starling'. These companies are responsible for understanding the fashion trends and mobile phone

Market Research: The Consumer Goods Market

companies will adopt these companies to incorporate designs and trends into the product appearance, but the actual workings of the phone would have been brought from bigger phone manufacturers.

3. Conclusions

It seems that there is an overall increase in demands for the targeted consumer goods across the country. However, more and more Company are seeing the benefits to move manufacturing overseas. Some are turning into this direction so to invest in more research and design in the UK, but most only use the UK as a distribution base and R&D is based in Europe.

Since consumer goods are very much like fast moving consumer goods because fashion change and consumers demands increases, competition increases. Customers are now the final arbiters in demand, need, design and quality. It can be interpreted that there should be more demand for engineering consultancy to assist in the research, design and development stage. However, most would either have their own in house team so that they would benefit from gaining knowledge advantage in house which competitors would not have, or that the cost of hiring external engineering consultancy's is just too much in comparison to the value of the good that is being sold at. Since fashion changes so quickly, a company will either have a faster turnover of products and concentrate more on marketing, or try to maintain competitiveness by training up people in house.

Either way, the report reflects that the market does utilise engineering techniques, especially FEA and CFD but this market may not be as fruitful as it seems from an engineering consultancy's point of view.

Appendix

Market Research: The Consumer Goods Market

Market Analysis Questionnaire - Consumer Goods

The aim of the questionnaire is to find out from design engineers/consultants in the consumer goods industry the engineering techniques used in the R&D phase of the product. This questionnaire is carried out by telephone interview.

The products targeted to demonstrate the consumer goods design stage requiring engineering techniques are:

- Washing machines
- Mobile phones

Question
1.What are the key designs and engineering problems you face in designing a product? <ul style="list-style-type: none">- E.g. Understanding the loads the product may experience- Predict its behaviour under various loads- Ensuring adequate fatigue life
2.Have you used any advanced engineering techniques in the research, design and development stages? <ul style="list-style-type: none">- Such as Mathematical modelling (prediction and simulating)- Computational fluid dynamics (fluid flow, heat and mass transfer)- FEA (assessing the stress of, say a particular area in a product. Can be used for all sorts of analysis like to measure the fatigue, cracks etc)- Testing with solutions
3. Do you have engineering consultants in house or outsourced? <ul style="list-style-type: none">- If the consultant is outsourced, does the consultant work in his/her own office or on contract based at your site?

Market Research: The Consumer Goods Market

4. Which do you feel will be the new techniques and applications offered by consultants/contractors, which will be used increasingly in the future in your industry?

6. Which are the most important trade journals in your industry, which would be read by decision makers etc?

8. What do you think would be the typical price paid per day/per hour in your industry for the sort of consultancy/contractor services we have been talking about?

Market Research: The Consumer Goods Market

References

Contacts-

Hoover: 01733 568989

James Hastie- Industrial Designer

Tim Morgan- Engineering Manager

Chris Henderson- Project leader

Seth Clifford- Project leader

Dyson: 020 78338244 Press Office

Dererk Sheldon Associates:

Derek Sheldon- Design Consultant

Motorola: 01793 541541

Pete Bishop- Engineering Manager 01793 565223

Hotpoint- 01733 568989 General enquiry

<http://gartner11.gartnerweb.com>

Handset supply catching up with demand. RCR 08/07/2000, Vol. 19 Issue 32, p1

Reuters Business Insight- telecoms & IT strategies for business

The best shape in the least time. Abdul-Salam M.Niazy.

<http://www.memagazine.org>

Making the most of design. Volume 1 Number 4 1994. Andrew lee-Mortimer. World Class design manufacture, Vol 1 No. 4, 1994, pp. 39-44

Critical factors in design. Crispin Hales. Mechanical Engineering Design 2001.

Market Research: The Consumer Goods Market

The use of experimental design in the development of new products. Marit Risberg Ellekjaer. International journal of quality science, Vol. 3 No. 3, 1998.

Streamlining product development. Mark Decker. Mechanical engineering design 2001.

Managing design for a quality product. John Fox. Assembly Automation. Vol. 15. No. 1, 1995, pp. 12-14.

Design engineering. Nov 2000, p12. What If?

Techniques. A method for measuring total value towards designing goods and services. Biren Prasad. The TQM Magazine. Volume 10. Number 4- 1998- pp. 258-275

The Defence Market

Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

1. Main Players in the industry

Table 1 shows leading defence suppliers by estimated defence-related turnover. These companies are profiled in Appendix A.

Table 1: Leading Defence Suppliers by Estimated Defence-Related Turnover (%), 1998 Source: Financial Times, 28th January 1999

Company	Defence-Related Turnover (%), 1998	Description
Vosper Thornycroft Holdings PLC	77	Main shipbuilder supplier to the British Royal Navy http://www.vosperthornycroft.co.uk/
British Aerospace PLC†	74	One of the biggest defence manufacturers in the world, Bae are primarily responsible for weapons, aircraft and systems http://www.bae.co.uk/
Hunting PLC	50	Responsible for weapons systems and battlefield communications for the UK armed forces http://www.hunting.plc.uk/
Vickers PLC	50	Manufacturer of the Challenger II tanks and armoured personnel carriers. www.vickersdefence.co.uk
General Electric Company†	33	According to Defense News, GEC ranked sixth among the top 100 defence firms worldwide, in terms of defence-related turnover, in both 1996 and 1997, communication systems, electronic systems, avionics and land systems
Racal Electronics PLC	32	Racal has three principle business activities: Telecommunications Services Defence Electronics Industrial Electronics
Rolls-Royce PLC	30	One of the biggest manufacturers of aero engines in the world for both defence and civilian markets http://www.rolls-royce.com/
GKN PLC	25	Aerospace and Special Vehicles GKN-Westland Aerospace is the helicopter manufacturer
Smiths Industries PLC	20	Smiths has three business groups, between which its turnover is divided roughly equally: Aerospace Medical Systems Industrial.

† A £7.7bn merger deal took place between British Aerospace (BAe) and GEC Marconi in 1999

2. Changes in the UK Defence Industry

The UK's defence/aerospace industrial base has been undergoing a period of profound change. Five significant forces underpinning the radical transformation of the global defence industrial base can be identified, each requiring a corporate response from the UK defence sector. These are:

- a). Significant reductions in current and future defence budgets, particularly in weapon procurement and military manpower requirements following the end of the Cold War. By 1999, global defence expenditure had reached its lowest level since 1966 and stood at about 40% below its peak 1987 level. For NATO, this represented a reduction from 3.3% of GDP allocated to defence expenditure to some 2.5%. For the UK alone, the share of GDP consumed by the defence sector declined from 5.2% to about 3.4%. While not unprecedented in either scale or range, the defence cuts of the 1990s necessitated significant strategic adjustment by defence suppliers.
- b). Simultaneous and intensified pursuit by governments of enhanced 'value for money' in defence expenditure. It is important to recognise that the sweeping defence expenditure reductions of the early 1990's followed a period in which, despite the massive commitment of public money to defence projects, governments had already begun to amend their defence procurement policies, placing greater pressure on defence companies to deliver enhanced efficiency and cost-effectiveness. In the UK, this process has been intensified recently with the SMART procurement initiative and the developments associated with the UK's Strategic Defence Review (SDR). Considerable cost savings are anticipated from the SMART procurement initiative, perhaps of the order of 30%, with government estimates amounting to savings of £2 bn over 10 years.
- c). The combination of high cost, high risk and extreme market uncertainty in new defence product development within the evolving post-Cold War business environment, has necessitated prime defence contractors to develop market survival and expansion strategies, including the formation of new

strategic alliances, technology partnerships and joint ventures to share the burden of cost and risk.

d). The necessity for large prime defence contractors to achieve global competitive advantage through a radical transformation of their supplier base, as the process of globalisation begins to affect the defence industry. The focus of the required revolution in the supplier base of the defence industry is now on the following.

- Minimising cost.
- Flexible response to changing market demands.
- Adoption of partnership arrangements between primes and preferred suppliers.
- Enhancement of customer service in terms of delivery, quality and service.

As noted above this new focus is changing the relative emphasis on different parts of the value chain.

e). The requirement for defence suppliers at all levels to adjust rapidly and smoothly to the newly emerging requirements of the defence market, as post-Cold War conflicts place new demands upon governments and world peace-keeping agencies. In particular, most leading members of Nato have begun to put in place rapid reaction forces to deal with regional conflicts as they emerge and are absorbing the lessons of the Gulf War, Bosnia and Kosovo, in the formulation of new military strategies.

In essence, then, the forces driving change in the defence sector during the 1990s combined to greatly intensify competition in a shrinking and unstable market with both prime contractors and their suppliers having no choice but to adopt radical strategies for survival and the maintenance of competitive edge.

3. The Strategic Defence Review

The Strategic Defence review from July 1999 is a wide-ranging review, it covers all aspects of defence from military personnel to Defence Diplomacy.

Defence diplomacy - preventing the conditions which lead to conflict - has been a key theme of the SDR. The review will mean a reduction in defence expenditure, in real terms, of £500M in the first year, rising to nearly £700M in the third year, as the efficiencies begin to take greater effect. In sum, a fall of 3% in real terms in the Defence budget by the end of this Parliament. The precise figures are as follows:

	1998/99	1999/00	2000/01	2001/02	1998/99 less 2001/02
CASH (£M)	22240	22295	22830	22987	
98/99 PRICES *CONSTANT	22240	21730	21709	21555	685
YEAR ON YEAR%		-2.3	-0.1%	-0.7%	-3.1%

The White Paper indicates where money will be spent, ranging from medical support to improved communications. Appendix B highlights the main acquisitions some of which could in turn have potential for consultancy work, through the prime contractors.

3. Post-Cold War Corporate Strategies in the UK Defence Industry

In the UK, as elsewhere, defence companies have attempted to increase their share of a declining defence market through enhanced efficiency and cost reduction; concentrating more on core business activities and pursuing long-range market positioning strategies, while targeting realistic short-term opportunities. In addition they have pursued collaborative strategies to share costs and risks, both horizontally and vertically, with the aim of benefiting from new defence procurement decisions and shared technology. They have also tried to enhance their civil business by harnessing and transferring technology and other operational assets from their defence business.

Some companies have sought to target growth in new market sectors through conversion and/or diversification, pursuing a combination of new product design and development, while refocusing their activities to access new geographic markets. They have adopted a joint venture/strategic alliance path to effect diversification; setting up distinctive new business ventures and

attempting to change their market profile through acquisitions and mergers. Very few, however, have succeeded in replacing the business lost through defence contraction from these new ventures.

4. The Future of the UK Defence Industry

Globalising forces will exert an increasing influence on the UK's defence, aerospace and systems' sectors. These effects include:

- Speeding up business transactions;
- Expanding the world market;
- Increasing the number of players in defence, aerospace and systems;
- Encouraging the increased use of alliances and partnerships;
- Facilitating technology transfer;
- Increasing competition;
- Creating a truly global supply chain;
- Generating tensions over intellectual property rights (IPR);
- Ensuring an increasing role for the World Trade Organisation (WTO) in regulating the world economy;
- Challenging the dominance of Western Europe and North America in defence, aerospace and systems;
- Transfer of manufacturing to less developed countries

What is clear already is that in the era of post-communism defence firms are being treated as less of a special case and are now expected to operate on more commercial criteria. In addition ideological shifts towards a ubiquitous acceptance of the free market are compelling governments to lower taxes, while still providing adequate social welfare. The result is lower defence budgets, which, coupled with rising equipment costs means some hard choices face both governments and defence firms.

The drive to reduce defence costs will inevitably mean a continuing focus on streamlining and re-engineering.

If defence budgets remain tight, as is likely, increasing efforts will be needed to export defence equipment as a source of revenue. But here we encounter a stark contradiction. If governments seek to tighten export controls on defence equipment, as is currently the case in Germany, the drive towards greater efficiency at the national and European level will be undermined. It should also be noted that the European Commission has plans to develop a common armament's policy, with EU level procurement via OCCAR (French acronym for *Organisme Conjointe de Coopération en Matière D'Armement* - The Organisation for Joint Armament Co-operation), linked to harmonised foreign and security policy. But, if individual nations are to place new limits on defence exports this initiative makes no sense. In short there are opposing values at work in the arena of defence harmonisation and rationalisation. UK R&D funding for both defence and civil aerospace has been on an overall downward trend since the mid-1970s. Indeed, between 1976 and 1996 R&D funding fell by some 35% in real terms. According to some commentators this has produced leaner and more efficient institutions, but it raises real concerns regarding the UK's future competitiveness. In the view of the Foresight DASP the UK needs to reinvigorate its research base if future competitiveness is to be assured. This is particularly so as the UK's main aerospace competitor, the USA, has continued to spend, throughout the 1990s, more than one billion dollars per annum on NASA aeronautical programmes aimed at the civil sector, while the DoD has funded aircraft related Research, Technology and Development (RT&D) at about \$5bn per year. In terms of UK research spending what needs to be clearly understood is that the technology now embedded in the UK's world class defence and aerospace products is based on research from 15 or 20 years ago.

European NATO nations budgeted \$10 billion on research and development (R&D) in 1998, less than a third of the \$36 billion allocated in the USA.

Europe devotes about 6% of the overall defence budget to military R&D and the USA 13%. This disparity has existed for some time and shows no sign of reducing. The knock-on effect for Europe on both military capability and civil technology spin-off could be profound.

4.1 Joint Strike Fighter –F35 (The FT, 26/10/01)

The jet, to be known as the F-35, will become the primary fighter aircraft for military forces in the US and the UK

Lockheed Martin, the US defence company, on Friday 26th October beat Boeing to carry out the biggest military programme in US history - the \$200bn (E224bn) project for the new joint strike fighter. BAE Systems UK and Northrop Grumman of the US are the main participants in the Lockheed team

Work on the Joint Strike Fighter secures thousands of jobs in the British aerospace industry over several decades, with Rolls-Royce and BAE Systems as the main beneficiaries. Hundreds of smaller contractors are also likely to win fresh work.

John Weston, BAE Systems' chief executive, welcomed the US Defense Department's decision to pick Lockheed-Martin.

"This involvement will ensure thousands of jobs throughout the UK and US now and in future as these aircraft are developed, produced and then supported and modified through their life cycles." He added: "The significance of this programme for UK armed forces is that the combination of Eurofighter and JSF enables the UK to field 21st-century capabilities in its defence and the defence of its allies."

About 3,400 jobs will be safeguarded or created in the design and development phase, while production will bring a further 8,400 jobs. Thousands more jobs are likely to be created indirectly in knock-on industries.

The rear fuselage will be built at BAE's Samlesbury site, near Preston. Much of the BAE and Rolls-Royce work is likely to go to Scotland, Bristol and Preston. The two UK companies were involved in the Lockheed and Boeing bids, ensuring a substantial role for Britain, which will contribute 10-15 per cent of the new aircraft.

BAE has been relatively untouched by the downturn in civil aviation, with 80 per cent of its £12.5bn annual turnover in the defence sector. The US Department of Defense is its biggest buyer, making up a large proportion of BAE's £4bn annual sales in North America.

The new JSF should go into production in 2010. The work is expected to go primarily to Bristol, where its engine thrust system is produced, although some of the work will go to other plants in Derby, Glasgow, and Sunderland.

5. The main types of Engineering Consultancy/Contractor Services used in the Defence Industry.

The amount of consultancy carried out for DERA has declined considerably over the past 6 years. In 1996-1997 Dera generated £87,576.00 for Eatec, by 1999-2000 this had dropped to £3,150.00. The reason for this dramatic decline was due to Ministry Of Defence policy, which led to a decrease in research expenditure in order to reduce costs. A look at engineering consultancy websites gives an indication of the type of work carried out for the defence industry, such as involvement in equipment design and software development. Appendix C, shows the defence section of the Fraser Nash Website.

* www.foresight.gov.uk was the main source of information for this document

The Expert Witness Market

Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

Market Research: The Expert Witness

Contents

1.	Introduction	3
1.1	Who is an Expert?	
1.2	The Characteristics of an Expert Witness	
1.3	The role of the Expert Witness	
1.4	How does the whole process start?	
2.	Recent changes in the Law: The 'new' system	6
3.	Recent Trends in the Expert Witness market	8
4.	How do parties go about finding Expert Witnesses?	11
5.	Conclusions	12
	Appendix	13
	References	15

Market Research: The Expert Witness

1 Introduction

1.1 Who is an Expert?

An expert is anyone with knowledge or experience of a particular field or discipline beyond the common norm. Most common expert witnesses are professionals, but there are also experts who do not have a degree but whose background and experiences qualifies them.

1.2 The Characteristics of an Expert Witness

It is productive to think beyond “Expert” to salesman, teacher and communicator. Expert witnesses needs to be persuasive people and good communicators. An expert witness will need to stand their ground because the goal of the opposing lawyer is to discredit the Expert. Some Lawyers may even try to rattle an Expert by making accusations concerning lack of professionalism and incompetence.

1.3 The role of the Expert Witness

Expert Witnesses are used to increase the credibility of a case. Expert evidence may be required in both civil and criminal cases as well as arbitrations and in specialist tribunals and inquiries. The principle roles of the expert witness are:

- Acting at all stages as independent experts in order to assist the parties in reaching a resolution of their disputes
- Narrowing the issues in dispute thus saving time and costs at trial
- Assisting the court in areas within the expert’s special knowledge

Their work in the civil courts is in helping to decide disputes between Parties involving some element of technology such as engineering by interpreting technical documents and data, explaining the state of technical knowledge in specific places at specific times and giving opinions on the likely technical consequences of actions taken by the parties. An expert does not ‘take sides’. His duty to the court

Market Research: The Expert Witness

to provide an honest case overrides the duty to the party who pays the expert witness.

A full-blown litigation is not the only way of settling technical disputes. Other cheaper, quicker and less formal procedures are arbitration, negotiation, mediation and other types of 'alternative dispute resolution'. In Expert determination, the parties normally place themselves in the hands of the independent Expert to make a decision, which they agree in advance to accept. Whereas formal arbitration involves reference to a court. Sometimes, parties may wish to pursue a settlement of the dispute by (friendly) negotiation. An Expert witness is then there to stand by the case, perhaps together with a business negotiator and solicitors.

1.4 How does the whole process start?

The process starts when a solicitor acting for either the claimant or the defendant writes to an expert witness asking whether he/she would be prepared to accept instructions in the particular case. The expert must decide that the case falls within the area of his/her expertise before agreeing to proceed. This is important because an expert is going to be tested on the opinion given.

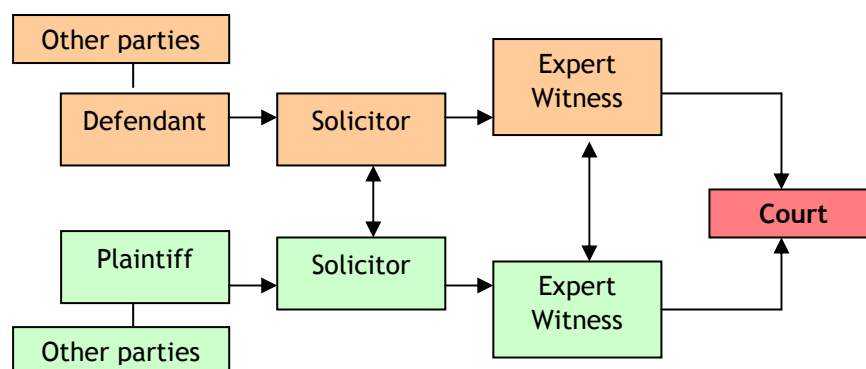


Figure 1: A simplified outline of the process

This is otherwise known as the 'old' system. Under the old system, the expert witness would receive instructions from the solicitor acting for one or more parties in a case, who, together, formed one of the 'adversaries'. The expert witness receives all the documentation produced by that side, which would then inspect machinery, a system of work, and a site. This inspection would generally be a joint

Market Research: The Expert Witness

inspection with an engineer (the expert witness) from the other side. The likelihood was that the other engineer would have a set of documents that had only a very small area of overlap with those that the other engineer received, but between the experts all relevant documents are seen. Independent reports are then prepared which are sent to their instructing parties. And most often, the sight of their respective engineer's report would persuade one side or the other to settle at this early stage. In concluding the settlement, the expert witness sends the bill to the instructing solicitor who pays it.

2. Recent changes in the Law: The 'new' system

The role of the expert witness in civil cases in England and Wales has seen some significant changes since April 1999 with the introduction of the Civil Procedure Rules 1998 (CPR). The old rule lead to problems associated with the 'hired gun' partisan expert. Under the CPR, the court has both the power and the duty to restrict expert evidence. The restrictions endorsed are not an attempt to stifle expert evidence but creates an obligation to limit such evidence 'to that which is reasonably required to resolve the proceedings'. An important procedure under the CPR is the court's direction for experts to discuss the issues as this helps narrow the issues of disagreement between the parties thus saving time on cost and delay.

Solicitors also share some of the responsibility for the partisan approach since it is not entirely unheard of for them to shop around to try and find an expert who is sympathetic to their client's case. But much of all this has been resolved with the introduction of the Single Joint Expert (SJE) under the CPR. Rule 35.7 (1) where the court may direct that the evidence on that issue is to be given by one expert only, if two or more parties wish to submit expert evidence on a particular issue.

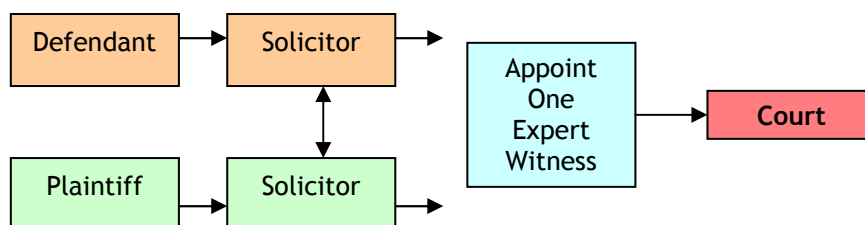


Figure 2. The Single Joint Expert under Civil Procedure Rule

If a party agrees to a joint report, it does not prevent that party being allowed facilities to obtain a report from another expert or to rely on the evidence of another expert to challenge the case. It is hoped that the point of this rule is that in the majority of cases it will not be the first step but the last step.

So under this new system, both sides, and all parties instruct the expert witness, as a single joint expert. Relevant documents are received from all sides. The expert

Market Research: The Expert Witness

witness makes an inspection, in the presence of the claimant and defendant (or their representatives, i.e. Solicitors). The expert witness then weighs the facts and evidence and forms an opinion in line with the facts and evidence and creates a report. Questions are asked from all sides in which the expert witness responds to all. Usually, a letter of instruction and all the documents are received from one solicitor, whom is regarded as the principal instructor. The bill is sent to the principal instructor who often pays a proportion of it on behalf of his clients and then omits to make any arrangements for the other instructing parties to pay the expert witness their portions, until the expert witness starts chasing for payment. It follows that under the new system, prompt invoicing by experts has become more necessary than ever.

3. Recent Trends in the Expert Witness market

As issues grow more and more complex, many sources (including calls to The UK Register of Expert Witness and The Society of Expert Witness) have expressed that there is an increasing use of expert witnesses who are in more specialist areas. Lawyers are calling more and more on experts to testify about final issues, which formerly might strictly have been left up to a jury.

What do the statistics say in Year 2001? The UK Register of Expert Witnesses has in total 3200 Expert Witnesses on their database. The Expert Witness survey 2001 was sent out to all 3200 Expert Witnesses and 482 forms were returned (16%). Of the 482, 200 were medical practitioners, 63 were engineers, 53 had scientific, veterinary or agricultural quality, 39 were in professions ancillary to medicine, 36 were surveyors or valuers, 24 were accountants or bankers, 17 were architectures or builders and others totalled 50, of whom 23 were psychologists. If we use the figure of the people who responded to the total expert witness as a ratio (482:3200), there would be about 418 (13%) Engineering Expert Witnesses just in the UK Register's of Expert Witness database. Although this does not represent the whole of the UK market, it generates a general idea in comparison to the other professions apart from medical practitioners (42%), which dominate the market (See Appendix). Overall, expert witness work accounted for, on average, just 37% of all of the above professions workload with the rest committing to their professions, but 90% of respondents of the survey that was carried out on the expert witness market expressed that they have been practising as expert witnesses for at least 5 years, and 63% had been undertaking this sort of work for more than 10 years.

In terms of writing reports for use in court and advice for the instructing solicitor and the client, four surveys was carried out by the UK Register of Expert Witness. In the 1999 survey, reports for the court were averaging 48 per year per expert and 19 for solicitors and clients. Now, these average annual totals have dropped to 41 and 12 respectively. It might seem at first that these figures contradict with what was said earlier that there seems to be an increasing use of expert witnesses who are in more specialist areas, however if we look at the averages carefully:

Market Research: The Expert Witness

	1999		2000
Reports for Court	48	↓ 15%	19
Reports for solicitors/clients	41	↓ 37%	12

Given the changes with the civil procedure rule, one would have thought that where every case only one expert is needed in place of two contributes a reduction of 50%. These figures can suggest that although the change in law, demand is still there in specialist areas.

There are still a number of reasons for this turndown of business:

Firstly, there have been a fall in the number of writs issued in both county courts and the High Court, and since April 1999 there has been a dramatic decline in the number of cases going to trial. Also, because more disputes are being settled before they reach court.

Secondly, under the Access to Justice Act 1999, a solicitor is able to recover from a losing opponent the success fee and any legal expense insurance purchased either supporting a conditional fee agreement or covering both sides costs subject to the Civil Procedure Rules and Practice Directions on Costs. The Conditional Fee Agreement Regulations 2000 set out the requirements for a Conditional Fee Agreement (CFA) to be enforceable. Although the forecasted growing use of CFAs as a means of funding litigation would result in an increased demand for reports of the advisory kind, in reality, 82% of experts replied that they had not been instructed in any reports of the advisory kind under CFA.

Thirdly, the biggest change of all over the past 2 years is the increased use of being made of single joint experts (SJE). The latest survey revealed that 80% of the experts who responded had acted as an SJE during the previous 12 months and that, on average, experts are being instructed in that capacity at least 12 times a year. And, of course, every case where one expert is instructed in place of two contributes to the overall reduction in demand for expert witness services.

The table below shows how much expert witnesses are charging within their professional group. On average, those for report writing have gone up by 8.5% per year and 5.6% per year for court appearances.

Market Research: The Expert Witness

Professional group	N*	Average rate per hour (£)			
		Writing reports		Court appearances	
		2001	1999	2001	1999
Medicine	200	149	136	927	850
Paramedical	39	100	68	718	512
Engineering	63	85	71	663	567
Accountancy, banking	24	133	135	895	987
Science, agriculture	53	78	79	648	577
Surveying, valuing	36	104	83	787	642
Architecture, building	17	84	77	712	612
Others	50	127	71	622	521
Totals	482	119	100	798	708

N is the total number of respondents in each professional group in the 2001 Survey by the UK Register of Expert Witness.*

4. How do parties go about finding Expert Witnesses?

A Lawyer needs to review the expert's qualification to determine whether they are a good fit for the case at hand. Usually expert witnesses may already have a CV, which lists all the qualifications making them qualified and a specialist in their field. The Source where parties may turn to for expert witnesses include:

- a. Personal referrals**
 - i. Lawyers
 - ii. Colleagues
- b. Jury verdict reporting services**
- c. Directories**
 - i. Expert Witness/Expert Consultant book
 - ii. Online directory of UK Expert Witnesses
- d. Society membership**
 - i. The Society of Expert Witnesses
 - ii. The UK Register of Expert Witnesses
- e. Trade associations**
 - i. The Solicitor's Journal (Advertising)
- f. Regulatory bodies**
 - i. The Academy of Experts
- g. Private consulting firms**
 - i. Eatec Limited
 - ii. DC White & Partners Ltd Consulting Engineers

A professional law librarian can also be a big help in obtaining a list of potential experts. Personal referrals are another excellent resource, particularly when that source is another lawyer who has won with the expert. Experts can also be found on university and college facilities.

5. Conclusions

Providing expert support to litigation matters is a challenge. Although lawyers are calling more and more on experts to testify about final issues due to increasing disputes, only one expert is instructed in place of two, which contributes to the overall reduction in demand for expert witness services.

A recommendation to play this game is perhaps to work part-time (25%) on expert witness work and try to build the reputation of Eatec within this field and develop networks within various fields of source to create awareness.

Eatec has the right qualifications because they have been in the business for over 10 years with highly qualified staff. The level of entry into this business is minimal but gaining reputable experience in the expert witness field takes time combined together with the right kind of marketing to create psychological awareness amongst solicitors and lawyers.

However, this line of business presents engineers like Eatec with an opportunity to truly heighten their awareness of technical detail, facts, rules, regulations and real-world occurrences while organising thought and preparing a presentation though well developed reasoning.

Appendix

Market Research: The Expert Witness

A- Total Expert Witness on UK Register of Expert Witness database:

3200 (100%)

B- Total respondents to Survey sent out:

482 (16%)

Profession:

N

Medical Practitioners

200 (41%)

Engineers

63 (13%)

Scientific, veterinary and agricultural qualification

53 (11%)

Professions ancillary to medicine

39 (8%)

Surveyors and valuers

36 (8%)

Accountants

24 (5%)

Architectures and builders

17 (4%)

Others

50 (10%)

Ratio: B:A

$(3200/482) \times N$

Medical Practitioners

1328 (42%)

Engineers

418 (13%)

Scientific, veterinary and agricultural qualification

352 (11%)

Professions ancillary to medicine

259 (8%)

Surveyors and valuers

239 (8%)

Accountants

159 (5%)

Architectures and builders

113 (4%)

Others

332 (10%)

Market Research: The Expert Witness

References

Gale Sanderson, Expert Witness librarian- Davis, Arnold, Cooper Solicitors

Sarah Capel, Sales and Marketing representative- Expert Witness/Expert Consultant directories

Teresa Baron, Membership Liaison Officer- Society of Expert Witnesses

Terri Kavanagh, Customer Services Manager- UK Register of Expert Witnesses

Smith, Derek. Being an effective expert witness. 1993 Thames Publishing

Blau, Theodore H. The Psychologist as Expert Witness. 1984 John Wiley & Sons, Inc

The Expert Witness: A Primer on Your Activities. Professional Safety, Jan 2002, Vol. 47 Issue 1, p34. Business Source Premier

Johnson, George L; Vallario, Cynthia Walker; Metcalf Jr., Robert T.p: An Expert Witness Can Make or Break a Case: Journal of Accountancy, Aug 2001, Vol. 192 Issue 2, p37. Business Source Premier

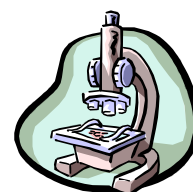
Baskind, Eric: The Expert Witness in England and Wales: The End of the 'Hired Gun'? An English Perspective. International Review of Law, Computers & Technology, Jul 2001, Vol. 15 Issue 2, p229. Business Source Premier

Babitsky, Steven. Becoming an Expert Witness. Civil Engineering, Apr 2001, Vol. 71 Issue 4, p54. Business Source Premier

Hansen, Mark. Experts are liable, Too. ABA Journal, Nov 2000, Vol. 86, p17. Business Source Premier

Cohen, Elizabeth J. Don't Take Experts From Strangers. ABA Journal, Apr 2000, Vol. 86, p74. Business Source Premier

The Medical Engineering Industry Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

Market Research: The Medical Engineering Industry

Contents

1.	Introduction- Background Literature on Medical Engineering Industry	3
2.	Medical Technology- European Market Facts	3
3.	Market Statistics	5
4.	Industry Bodies	6
5.	Who uses Mechanical Engineering Techniques in the Field	7
	5.1 Armstrong Healthcare	8
	5.2 University of Bath, Dept. Mechanical Engineering, Faculty of Engineering and Design	9
	5.3 Philips Medical Systems	10
	5.4 WS Atkins	11
	5.5 SMS Technologies Ltd	12
	5.6 Sulzer Medica	13
	5.7 Bath Institute of Medical Engineering (BIME)	13
	5.8 DePuy International Ltd. (a Johnson & Johnson Company)	14
6.	Conclusions	16
	References	18
	Appendix	20

Market Research: The Medical Engineering Industry

1. Introduction- Background Literature on Medical Engineering Industry

Medical Engineering has been identified as a priority growth area both nationally and internationally. According to Professor Ian Sutherland (2001, September) a former Chairman of AIME (The Profession- Professor Ian Sutherland, Past Chairman of AIME¹), the UK with its track record of invention and research in Medical Engineering is uniquely placed to take a lead in a world market that is developing at between 9-10% per annum. However, there are a number of hurdles to overcome. The UK market is only expanding at 3% per annum, over 90% of the UK medical engineering companies are Small Medium Enterprises and the UK's record of exploiting its good ideas and inventions is poor.

The Royal Academy of Engineering, recognising the potential of this emerging technology, has established a focus group on Medical Engineering, which has brought together a number of organisations concerned with medical engineering including research councils, government, industry and academia. AIME evolved from this focus group. The main aims of AIME are to promote technology transfer and industrial competitiveness in Medical Engineering and to promote research, development and manufacturing in Medical Engineering (AIME, 2001).

2. Medical Technology - European Market Facts

The EU Medical Technology Industry encompasses a great variety of products. Important new technologies have been successfully introduced into healthcare products and, as a result, the medical technology industry has contributed significantly to the increase in life expectancy of 8 years in Europe in the last 30 years.

Medical Technology covers a very wide range of products: aids for the disabled, active implantable devices, anaesthetic/respiratory devices, dental devices, electromedical, hospital equipment (hardware), imaging, in vitro diagnostic devices, ophthalmic and

¹ <http://www.org.uk/aime/profn.htm>

Market Research: The Medical Engineering Industry

optical devices, passive implantable devices, single use (disposable) devices, surgical (reusable) instruments.

Medical Technology and devices are often not recognised in their own right and therefore confused with pharmaceutical products. Table 1 compares the two industries, it is taken from the Eucomed website. Eucomed is a representative Body for the European Medical Technology and Devices Industry (<http://www.eucomed.be>).

Medical Technology Products	Pharmaceutical Products
<ul style="list-style-type: none">▪ Relatively young industry	<ul style="list-style-type: none">▪ Industry with long historical background
<ul style="list-style-type: none">▪ Based on mechanical, electrical and materials engineering	<ul style="list-style-type: none">▪ Based on pharmacology and chemistry. Now encompassing biotechnology, genetic engineering etc
<ul style="list-style-type: none">▪ Industry is made up of a few large companies and a large number of very small companies. The industry is extremely diverse.	<ul style="list-style-type: none">▪ Industry is comprised primarily of multinationals
<ul style="list-style-type: none">▪ Designed to perform certain functions based on performance and safety	<ul style="list-style-type: none">▪ Product development by trial and selection on basis of quality, safety and efficacy
<ul style="list-style-type: none">▪ Biologically inactive: effective by mechanical and electrical action	<ul style="list-style-type: none">▪ Biologically active: effective when absorbed into the human body
<ul style="list-style-type: none">▪ Regulations are part of the European “New Approach”▪ Conformity is based on manufacturer self-certification backed by Quality Management Systems and compliance systems together with conformity to harmonised standards▪ Additionally, high-risk devices are subject to pre-market product approval▪ Controls and requirements increase in proportion to product risk▪ Notified bodies are appointed by the governments to certify the conformity assessment procedures.	<ul style="list-style-type: none">▪ Regulations based on pre-market approval/licensing of individual products and strict testing regime▪ All medicines are subject to product approval however conventional▪ Pharmaceuticals are registered by EMEA (European Medicines Evaluation Agency) and the Member States Health Department
<ul style="list-style-type: none">▪ Short term development▪ Continuous Innovations and improvements based on new science, technology and available materials▪ Short product life-cycle: many registers are in	<ul style="list-style-type: none">▪ Long term development▪ Continuous innovation and some improvements based on new science and technology▪ Extensive product life cycle with long-lasting tests for

Market Research: The Medical Engineering Industry

place to track long term effects of implants	side effects
▪ Short investment recovery period	▪ Long investment recovery period
▪ Majority of new products consist of modifications of existing products using established and new technology materials	▪ Each new product is unique

Table 1- a comparison between medical technology products and Pharmaceutical products

3. Market Statistics

World market: 160 Billion EURO in 2000

Europe:.....24.5%....39 Billion EURO

USA:.....41.5%....60 Billion EURO

Japan:.....15%.....24.5 Billion EURO

Rest of World: 19%.....36.5 Billion EURO

European market: 39 Billion EURO

Germany: 36%.....14.3 Billion EURO

France:.....19%.....7.6 Billion EURO

UK:.....10%.....3.9 Billion EURO

(Source: EUCOMED member estimates, HIMA; Jan-Feb 2000 data)

The medical technology products market has many niche product lines each representing a modest market share. Each product requires specific manufacturing or distribution skills with the result that many small and medium size companies concentrate on a single product line or on a specific geographical area. This makes market segmentation a crucial task if Eatec is to develop in this industry. This would also imply that developing

Market Research: The Medical Engineering Industry

in this market would require a certain amount of expertise and knowledge in a particular medical field because here, business relationships are based on trust and past experiences. This is explored later in the report.

4. Industry Bodies

The Association of British Health-Care Industries (ABHI) is the lead trade association for the medical systems industry in the UK. This sector comprises not only manufacturers of medical devices, equipment and consumables, but also service companies, distributors, professional groups (such as architects and lawyers), and other suppliers to the medical community. www.abhi.org.uk

In July 1999, ABHI was contracted by the Engineering and Physical Sciences Research Council (EPSRC) to manage a new sector in their Innovative Manufacturing Initiative (IMI). The initiative is a source of funds for industry-led collaborative research projects in strategically important sectors of the British manufacturing industry. Up to half of the project costs are met through public funds with the rest coming from industry, in cash and kind. The new sector, called IntHeTech, will focus on Integrated Healthcare Technologies. The ABHI expressed that the programme will represent a significant opportunity for the British medical engineering industry and leading academic and health-care groups to collaborate in research that will lead to an increase in competitiveness both in the UK and abroad.

<http://www.abhi.org.uk/inthetech/index.html>).

Since Medical Engineering is recognised as being an important and growing industry in the UK and Internationally, the Medical Engineering Board at the IMechE (The Institution of Mechanical Engineers is the United Kingdom's qualifying body for mechanical engineers) was set up to assist the growth through professional channels and opinions from the IMechE.

Market Research: The Medical Engineering Industry

Although there have been a number of literatures written about developments in the medical engineering field, it does not observe the extent of implementation with mechanical engineering techniques that is being carried out in across this field. It does seem to imply, however that medical engineering, and its generalised attributes relating to systems of engineering and the physical science probably makes it impact the most in work relating to human biological systems (Dr. Peter Lawes, Chairman of the Medical Engineering Board 2001) rather than medical equipment.

In order to gain an insight into this complex field, people who are actually in the business from a few organisations were contacted from various niche product areas.

5. Who uses Mechanical Engineering Techniques in the Field?

Technology is key to the industry. According to literature from Fluent (a leading provider of CFD software) CFD is widely used in the medical industry, to analyse manufacturing processes, device performance, physiological flows, fluid structure interactions and the effectiveness of drug delivery systems. Fluent defines CFD in particular as an extremely valuable computer simulation technique in reducing risks in experiments to animal or human subjects. They have demonstrated that Medtronic Inc. has benefited in using CFD for the design of blood handling devices. In another application, scientists at the Center for Devices and Radiological Health, U.S. Food & Drug Administration (FDA) used CFD to investigate the role of spinal anaesthesia catheter design in some previously mysterious neurological injuries. Vygon used numerical flow simulation methods to evaluate several die designs for multi lumen tubes.

Bringing the discussion back to the UK, a number of experts were interviewed from various product backgrounds to try and gain an indication of who may use mechanical engineering techniques.

5.1 Armstrong Healthcare

Armstrong Healthcare Limited is the leading supplier of intelligent medical robotics for surgery. Dr. Patrick Finlay at Armstrong Healthcare is a member of the Medical Engineering Division Board. It was found that FEA was used through out the work carried out on the products. Kinematics² equations are also routinely used to design the robot envelope. CAD is certainly used in most cases in the drawing room. A new tool adopted by many industries is being used here in the medical industry known as Rapid Prototyping- Stereolithography³. Dr. Finlay agrees with most literature that mechanical engineering techniques are applied usually only in the high technology firms, in particular where the human biological systems is concerned such as joint replacement or wound care (mesh for wounds). A few examples of Companies Dr. Finlay gave was Johnson and Johnson, Smith and Nephew, DePuy International and Stryker Howmedica Osteonics, a global leader in the reconstructive orthopaedic device business. Products such as wheelchairs to operating tables do not benefit from using such advanced techniques because these are 'very low tech'. In Dr. Finlay's own words, "Unless you're a wacky company like us, or are a big international company, then most SME's do not choose to use mechanical engineering techniques as often as the bigger players."

Armstrong Healthcare is an example where mechanical engineering techniques are used not only in work relating to human biological systems, but also in the higher technology end of the market such as medical robots and machines. However, to identify more Companies who are like Armstrong Healthcare, who use leading edge technology to create high tech medical products will be difficult but it potentially sounds like a good market for Eatec to establish services because although it is only a small area, it is an area where sophisticated engineering work would be appreciated.

² Kinematics is the science of motion

³ Stereolithography (*STL for short*) means three-dimensional printing. Rapidly produces accurate scale models of engineering designs in graphic files in STL format and transferred to a desktop computer. This computer drives a laser beam, which traces out the details of the three-dimensional shape, layer by layer, on the surface of the liquid resin. The resin hardens where struck by the moving pinpoint of laser light and a solid plastic model is produced.

Market Research: The Medical Engineering Industry

5.2 University of Bath, Department of Mechanical Engineering, Faculty of Engineering and Design

Professor Tony Miles and Dr. Tony Mileham were interviewed at the University. Prof. Miles is currently working on a project in the medical industry using mechanical engineering techniques.

Parallel to Dr. Finlay's response, Professor Miles also suggested that it is the International Companies who have in house capabilities to carry out big research and development work. Most big companies do have their own engineering teams. A few international companies were named including: Johnson and Johnson, DePuy International, Smith and Nephew, Stryker Howmedica Osteonics, Zimmer Ltd and Biomet. Sometimes, the big companies take over a small company if they feel that a research that is carried out by the small company is attractive to them.

Then there are the small companies. There are a number of SME's with fewer than 50 people dominating the market. The small companies who are more ambitious develop new ideas and are more willing to apply advanced mechanical engineering techniques in their testing and simulation work. These are the companies who are more likely to approach external consultancies due to lack of in house expertise.

In the medical area where the human anatomy is concerned, the process starts with a surgeon who has an idea and approaches a company to take the idea up, or it may be that the surgeon has identified a particular need in the market, hence developments are usually very market driven. Prof. Miles talks of examples like Bone graft material due to loss of bone graft or new joint implants because the population lives longer. These markets requires a certain amount of background understanding in human anatomy in order to carry out appropriate CAE and it is an area which will benefit and use mechanical engineering techniques frequently such as CFD and FEA. Universities and

Market Research: The Medical Engineering Industry

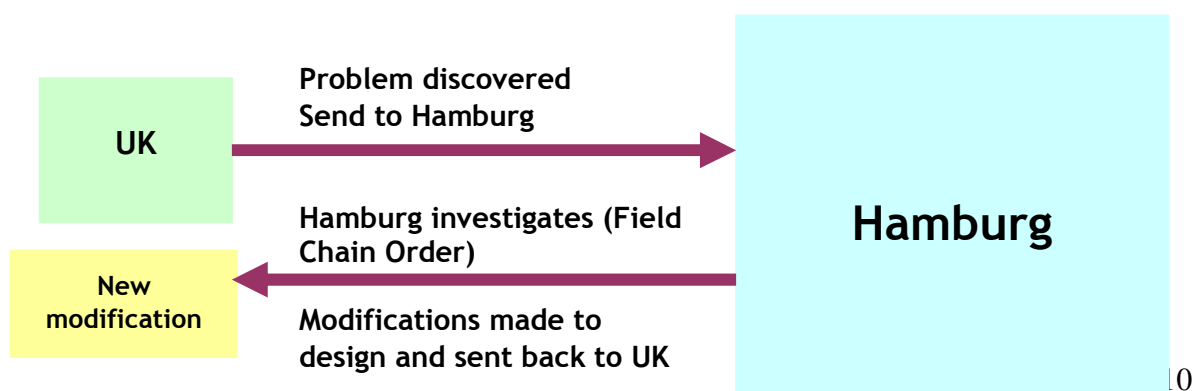
research centres usually get the work because these are perceived as independent authorities that are keen on developing knowledge rather than profit (Professor Miles, 2002). This is the kind of attitude, which Eatec should adopt if entering this market.

Most companies and consultancies founders are those who have come out of the bigger companies, such as Dr. Peter Lawes, Chairman of the Medical Engineering Board who used to be in Pfizer. Since they already have inside track into the market, it makes it easier for them to obtain consultancy work. Eatec will need to gain as much experience as possible in gaining work in the medical field and to develop a trust in the consultancy name in the market before becoming too specialised in one product area.

5.3 Philips Medical Systems

Philips Medical Systems is firmly established as the global leader in most of its markets. Philips' product line includes best-in-class technologies in X-ray, ultrasound, magnetic resonance, computed tomography, nuclear medicine, PET, radiation oncology systems, patient monitoring, information management and resuscitation products.

Adrian Simmons was interviewed. In the case of large international organisations like Philips, most developments in medical equipment industry would be carried out at the headquarters, in this case Hamburg. In the UK, only maintenance is carried out. Below shows how the process is carried out:



Market Research: The Medical Engineering Industry

Simmons also suggested that big companies like Siemens and GE also have a similar system. The findings in this interview suggest that international companies are not a good target for Eatec. It would make sense to target the SME's in the UK if business developments are to be achieved in this industry. This would probably make sense as Prof. Miles had suggested that it is usually the SME's who take the idea forward and when implemented, the big companies take over. As a long-term prospect, the success of a small company acts as bait into leading one into a bigger business. Is this the case? It was felt that a potential competitor's opinion would add an interesting input and WS Atkins was contacted.

5.4 WS Atkins Consultants

Stuart Kelly, a consultant in WS Atkins was contacted. WS Atkins Consultants Ltd. is one of the world's leading providers of professional, technology based consultancy and support services. The Consultancy provides a number of services including advanced engineering analysis and simulation, R&D, software & systems engineering, safety & reliability assessments and multi-disciplinary specialist projects.

The Company has provided a very detailed leaflet about the benefits of using fluid dynamics (CFD) in the medical industry, such as for analysing the blood flow through a bileaflet heart valve, blood flow at a needle tip and arterial system simulator. For WS Atkins, the medical industry only occupies a small part of the business because there is not a significant demand for mechanical engineering consultancy. There tends to be more work leaning towards the implantable products due to safety reasons and regulations. Therefore, advanced engineering testing and simulation is necessary to meet these requirements. Otherwise most products are just modifications of past designs and prototypes can be produced to test the actual model rather than using simulation. In comparison to the Aerospace or Automotive industry, the medical industry is behind in terms of attitude.

Market Research: The Medical Engineering Industry

5.5 SMS Technologies Ltd

SMS Technologies has been a specialist contractor to the medical industry for over ten years. The areas they work in includes⁴:

- Electronic and mechanical products to the medical and pharmaceutical industries
- Injection moulding to meet the needs of the medical and precision engineering industries
- High quality machining services to meet the needs of the medical engineering industry
- High quality finishes to meet the needs of the medical and precision engineering industries

Peter Parnell in the design and engineering department was interviewed and the findings are in alignment with those of WS Atkins. Parnell expressed that not many people he knew in the medical industry use mechanical engineering techniques much apart from the bigger companies. Perhaps the most used is design 3D modelling packages CAD, because most of the work carried out is legacy product and it all boils down to experience. All that is done is to implement changes to a product rather than create a new product since most of the specifications are validated anyway.

If a problem is encountered, then a prototype is produced to test the problem because unlike an aeroplane, which would be too costly to make a prototype for each testing, most medical industry instruments are relatively manageable in size. The cost of the services do not make the product any better than if it were tested with a prototype.

⁴ <http://www.sms-technologies.co.uk/>

Market Research: The Medical Engineering Industry

5.6 Sulzer Medica

Sulzer Medica develops, manufactures, and markets mechanical and biological implants for patients all over the world. David Stevenson in the R&D engineering department for fatigue testing was interviewed and the findings are very similar to the other respondents. Stevenson added that CAE is only used routinely and very cautiously. Since it is dealing with the anatomy, each patient's reaction is different and therefore, each person is like a project in its own right. The interview verifies that it is a very hard market to break into if one does not have a background in understanding the human anatomy.

In order to get a balance of the medical industry, apart of interviewing companies who deal mainly with implant instruments; it was interesting to see if the lower technology end of the market also uses mechanical engineering techniques in the product development process.

5.7 Bath Institute of Medical Engineering (BIME)

BIME was established as a centre for the design and development of medical equipment. The Institute designs and manufactures solutions for disability and healthcare.

Roger Orpwood was interviewed and the findings revealed that products and equipment in the higher technology end of the market including implants and devices of that level will require the use of sophisticated tools to analyse the stress placed on the structure and that it is safe. Not that many large companies are in the rehabilitation field and small companies would not get too involved with CAE.

Market Research: The Medical Engineering Industry

In BIME, FEA is often used in the design and development stage of rehabilitation equipments and robotics, where understanding the extent of loads a product can take is essential. Equipment such as wheelchairs are in the very low end and therefore, companies who manufacture equipment of that nature in the medical field will not require or spend large amount of money on advanced engineering techniques, unless of course the equipment is to be used in situations where unnatural strain is being imposed, such as racing wheelchairs, then FEA may be used.

There is a forecast that mechanical engineering techniques will be applied much more in the coming years. Therefore, Universities are encouraging their engineering undergraduates to apply more advanced engineering analysis and simulation in assisting with project work. This may imply a possible growing trend in using advanced engineering techniques in future work (Roger Orpwood, BIME 2002).

5.8 DePuy International Ltd (a Johnson & Johnson Company)

DePuy is the oldest manufacturer of orthopaedic implants in the United States. DePuy International has headquarters in UK, and works in partnership with healthcare providers.

Although the nature of the Company (orthopaedic implants) may not be a potential target for Eatec to develop growth, the findings provided some useful support information to the other respondents' feedback.

Richard Farrar was interviewed and it was expressed that FEA was used quite extensively because there are inexpensive small FEA systems developed to be used by non-FEA experts. However, most companies do not have a vast amount of expertise in house, therefore consultancies will be brought in to do analysis work. When the respondent was

Market Research: The Medical Engineering Industry

asked about the difficulties for consultancies to enter the market, Farrar stated that having a track record in the medical field does not guarantee one project work. What is more important is that the consultancy have the expertise and experience in the various engineering techniques, testing and analysis knowledge in carrying out the project (Richard Farrar). From web searches carried out, it would appear that Universities provide most of the consultancy services in the industry. Other techniques used in the industry include mathematical modelling (Kinematics) as in Armstrong Healthcare, leading supplier of intelligent medical robotics for surgery.

6. Conclusions

It has been recorded in a number of literatures that UK has a track record of research in Medical Engineering and that it is identified as a priority growth area both nationally and internationally. Universities, Associations and Institutes are providing much of the research in applying mechanical engineering techniques in the high technology end of the medical field, resulting in a substantial improvement in performance. It is recognised that simulation can provide faster time to market and reduced development costs.

The high technology end of the medical field include cardiovascular equipment, Orthopaedic Equipment to Medical Robotics. These are the areas that would really benefit from advanced simulation techniques, which provides more design data than physical testing.

It would make breaking into the market easier if one is already on the inside track and have evolved from a medical industry background, but entering the medical field with an attitude to assist in solving research problems rather than carry out standard analysis work like some industries is probably the way in. Getting involved with conferences, talks at the Universities may assist with Eatec establishing contacts with the medical industry as it seems that still much of the research to date is carried out in Universities.

Market segmentation needs to be carried out carefully and to a more detailed level. This is to understand how the market is split up and which are the niche products. It would be necessary to identify the companies who carry out the major development work in the UK and those who are small but extremely ambitious and want to make a difference in the market by using leading edge technology. It is felt that the market is still very young and it may be an advantage for Eatec to learn and work with the market while it is still in it's embryonic stage.

Market Research: The Medical Engineering Industry

Respondents did not talk of any other general simulation and testing or load measurements. It would be useful to find out if the lack of this information is because:

- Engineering application to medical engineering work is still new and these techniques are yet to be discovered ?
- They use their own way of simulation testing that is unique to Medical Industry?

The market was extremely diverse and complex; hence the information provided in this report should only be used as an exploratory insight into the medical industry.

Market Research: The Medical Engineering Industry

References

Contacts:

Adrian Simmons, Philips Medical Systems. 01737 230400

David Stevenson, Sulzer Medicare. 0141 812 5555

Dr. Patrick Finlay, Armstrong Healthcare. 01494 441446

Peter Parnell, SMS Technologies Ltd. 01279 406000

Richard Farrar, DePuy International Ltd. 0113 2700461

Roger Orpwood, Bath Institute of Medical Engineering. 01225 824103

Stuart Kelly, WS Atkins. 01454 201999

Professor. Tony Miles, University of Bath, Department of Mechanical Engineering,
Faculty of Engineering & Design. 01225 826368

Professor Tony Mileham, University of Bath, Department of Mechanical Engineering.
01225 826826

Articles:

Fluent. *Using Fluent CFD Software & Services*. 2001

AIME- Association of Institutions concerned with Medical Engineering. 2001.
[<http://www.aime.org.uk>]

Market Research: The Medical Engineering Industry

Bath Institute of Medical Engineering. The Wolfson Centre, RUH Combe Park, Bath.
BA1 3NG

AIME- Terms of Reference. December 14th 1999.

Keyvan, Keyhani; Banerjee, Rupak; and Hajiloo, Shoreh; *Computational Fluid Dynamics. Streamlines Design and Manufacture of Medical Devices*. Journal articles by Fluent Software Users JA102. Fluent 1999

WS Atkins. Fluid Dynamics for Medicine. By Stuart Kelly

Medical Engineering Matters. The Newsletter of the Medical Engineering Division. Issue No 02/01. I Mech E

Appendix

Accessed on- <http://www.themedweb.co.uk/byproduct.products.html>

PRODUCT DIRECTORY

Select product group on index to find the Manufacturers

[Find Manufacturers & Suppliers in our full Alphabetic listing](#)

Anaesthetic Equipment

[Actamed Ltd 01924 200550 Fax 01924 200518](#)

Anaesthesia Technology Ltd 01937 587001 Fax 01937 587002

[Blease Medical Ltd 01494 784422](#)

Cestradent / McKesson Equipment 01246 276111 Fax 01246 230825

[Charter Kontron Limited 01908 646070 Fax 01908 646030](#)

Dankroy Ltd 0208 445 2157 Fax 0208 445 0538

Deanestor Ltd 01623 420041 Fax 01623 420061

Dental Linkline 01942 671491 Fax 01942 680096

Howorth Airtech Ltd 01204 571131 Fax 01204 862378

Hospital & Technical Services 01246 451030 Fax 01246 456971

[MIE Ltd 01395 225222 Fax 01395 277660](#)

[SMS Technologies Ltd 01279 406000 Fax 01279 406001](#)

Apnoea Alarms

Ferraris Medical 0208 805 9055 Fax 0208 805 9065

Audiology

[GM Instruments Ltd. 01294 554664 Fax 01294 551154](#)

Guymark UK Ltd 01883 346969

Medtex Ltd 0121 565 1910 Fax 0121 588 1398

Nobel Biocare (UK) Ltd 01895 430650 Fax 01895 430636

[Norlite Medical Ltd 01358 742878](#)

Oticon Ltd 01698 283363 Fax 01698 284308

Autoclaves

Dentaquip Ltd 0289 260 1000 Fax 02089 267 6550

Dixons (Surgical Instruments) Ltd 01268 764614 Fax 01268 764615

SPS Dental (Sales) 01992 787870 Fax 01992 651730

Batteries

[Advance-Galatrek 0800 269 394 Fax 01978 810 852](#)

All Batteries 01923 770044

Cellpak Solutions 0191 427 4577

[Combat Alexander Batteries 01394 671763 Fax 01394 671797](#)

[Creasefield Ltd 01460 54800 Fax 01460 57201](#)

[Duracell 020 8560 1234](#)

[Euro Energy Resources Ltd 0116 234 0567 Fax 0116 235 4183](#)

Beds & Mattresses

[Actamed Ltd 01924 200550 Fax 01924 200518](#)

Harvest Healthcare 0114 270 1160 0114 275 6500

Hoskins Medical Equipment 0121 607 5515 Fax 0121 707 6688

[Huntleigh Healthcare Ltd 01582 413104 Fax 01582 459100](#)

KCI Medical Ltd 01929 556311 Fax 01929 553967

[Park House Healthcare Ltd 01924 441881 Fax 01924 440631](#)

[Pegasus Limited +44\(0\) 1705 784200 Fax +44\(0\) 1705 784250](#)

[Sareo Healthcare Ltd + 353 21 4634092 Fax + 353 21 4634093](#)

Sonesta 01978 664668

Blood Warmers

[Actamed Ltd 01924 200550 Fax 01924 200518](#)

[Althin Medical Ltd 01223 427600](#)

Jepson Bolton Co. Ltd 01293 249492 Fax 01293 249751

[JMW Medical Ltd 0131 448 0205 Fax 0131 448 0208](#)

Trio Diagnostics Ltd 01904 489334 Fax 01904 488668

YSI UK Ltd 01252 514711 Fax 01252 511855

Cardiac Monitoring

[Actamed Ltd 01924 200550 Fax 01924 200518](#)

Cardiacare Ltd 0207 935 5446 Fax 0207 487 2590

Cardiac Recorders International Ltd 0208 364 7000 Fax 0208 364 7716

[Cardiac Services 01232 669000 Fax 01232 687100](#)

[Charter Kontron Limited 01908 646070 Fax 01908 646030](#)

[Danica Biomedical](#)

[Marquette Hellige 01536 316200 Fax 01536 316205](#)

Nihon Koden 0208 814 2333 Fax 0208 814 2666

[Norlite Medical Ltd 01224 573582 Fax 01224 572436](#)

[Philips Medical Systems 01737 230400 Fax 01737 230401](#)

Cardiovascular Equipment

Market Research: The Medical Engineering Industry

[Aortech International plc 01698 746699 Fax 01698748474](#)
[APC Cardiovascular Ltd +44 \(0\)1270 216142](#)
[Autogenics Europe Ltd 0141 946 4488 Fax 0141 946 9333](#)
[Beaver Medical Products Ltd 01604 499427 Fax 01604 492212](#)
[Caterham Surgical Supplies Ltd 0208 683 1103 Fax 0208 683 1105](#)
[Caledonian Medical Ltd. 01698 845511 Fax 01698 845456](#)
[Charter Kontron Limited 01908 646070 Fax 01908 646030](#)
[Haemonetics \(UK\) Ltd. 01698 819700 Fax 01698 811811](#)
[Healthcare Equipment & Supplies Ltd 0207 486 4245 Fax 0207 486 4246](#)
[Jostra UK +44 \(0\)1698 849 800 Fax +44 \(0\)1698 844 646](#)
[Marquette Hellige 01536 316200 Fax 01536 316205](#)
[Medstone 01383 821890 Fax 01383 821877](#)
[Moulton Surgical International Ltd 01604 883700 Fax 01604 883788](#)
[Philips Medical Systems 01737 230400 Fax 01737 230401](#)
[St Jude Medical 024-76-716226 Fax 024-76-716212](#)
[Sulzer Vascutek 0141 812 5555 Fax 0141 812 7170](#)

Chiropody Equipment

[Castellini \(UK\) Ltd 0115 986 5200 Fax 0115 986 4122](#)
[Footmans Co. Ltd 0161 627 4401 Fax 0161 633 5333](#)
[Kays Medical 0151 207 5117 Fax 0151 207 3384](#)
[MEDesign Ltd +44 \(0\)1704 542373 Fax +44 \(0\)1704 545214](#)

CPAP Equipment

[CPAP Direct 713-526-7150 Fax 713-524-0650](#)
[CPAP/PRO 310-454-4333 Fax 310-459-1575](#)
[Fisher & Paykel Healthcare 01628 626136 Fax 01628 626146](#)
[Friday Medical](#)
[Mallinckrodt 020 7380 9420](#)
[Medic Aid 01243 846111 Fax 01243 846100](#)
[NIDEK Medical 205-856-7200 Fax 205-856-0533](#)
[ResMed \(UK\) Ltd 01235 862997 Fax 01235 831336](#)

Cryogenic Equipment

[Cryo Medical Instruments Ltd 01623 424200 Fax 01623 424777](#)
[Fern Developments Ltd 01355 229464](#)
[H+O Equipments +32 53 85 35 36 Fax +32 53 83 20 04](#)
[NMT Spemby Medical 01264 345700 Fax 01264 332113](#)

Defibrilators

[Artemis Medical Ltd 01322 628877 Fax 01322 628878](#)
[Beaver Medical Products Ltd 01604 499427 Fax 01604 492212](#)
[Charter Kontron Limited 01908 646070 Fax 01908 646030](#)
[Ferno \(UK\) Ltd. +44 \(0\)1274 851999 Fax +44 \(0\)1274 851111](#)
[Laerdal Medical Ltd 01689 876634 Fax 01689 873800](#)

Market Research: The Medical Engineering Industry

[Medical Research Laboratories Inc. 847.520.0300 Fax 847.520.0303](#)

[Philips Medical Systems 01737 230400 Fax 01737 230401](#)

[Physio Control UK Ltd 01256 782727 Fax 01256 782728](#)

[Zoll Medical \(UK\) Ltd 0161 877 2883 Fax 0161 877 2884](#)

Dental Equipment

A-Dec Dental UK Ltd 0121 327 2061

Attenborough C & LE Ltd 0115 947 3562 Fax 0115 950 9086

BDF Healthcare 01465 714848 Fax 01465 713857

BDG Ceramics 01382 225985 Fax 01382 229866

Bracon Ltd 01580 817000 Fax 01580 819455

British Dental Association 0207 935 0875 Fax 0207 487 5232

Brookwick Ward & Co Ltd 01592 630052 Fax 01592 630109

Central Dental Manufacturers 0114 272 5780 Fax 0114 289 0575

Chelmsford Dental Laboratories 01245 257576

Cottrel & Co. Ltd 0208 893 3758 Fax 0208 893 3647

Courtin Ltd 01359 251088 Fax 01359 251248

Davis Healthcare Services Ltd 01707 646330 Fax 01707 646429

Davis Schottlander & Davis Ltd 01462 480848 Fax 01462 482802

Dental Manufacturing Engineering 01452 415540 Fax 01452 307187

[Dental Technology Services 0141 556 5619 Fax 0141 551 9162](#)

DentalEZ Dental Products 01442 269301 Fax 01442 217594

Dentsply Ltd 01932 853422 Fax 01932 840168

DPNova Ltd. 0141 420 1111 Fax 0141 420 3338

[Ecosse Hospital Products Ltd. +44 \(0\)1980 843666 Fax +44\(0\)1980 843555](#)

Evacryl Dental Supply Co. 0208 452 5338 Fax 0208 208 1183

Forestadent Ltd 01908 568922 Fax 01908 560611

Healthcare Direct Ltd 0208 236 0060 Fax 0208 236 0070

Kent Dental Ltd 01634 878787 Fax 01634 878788

Kerr (UK) Ltd 01733 260998 Fax 01733 262096

Mercian Surgical Supply Co Ltd. 0121 429 1133 Fax 0121 429 4983

Metrodent Ltd 01484 461616 Fax 01484 462717

MR Dental Supplies Ltd 01483 724116 Fax 01483 740548

Murray Equipment Co. Ltd 01243 527791 Fax 01243 776603

Nessor Equipment Co. Ltd 0208 852 8545 Fax 0208 852 1230

Oral Plastics 01253 723181 Fax 01253 714909

Panadent Ltd 0207 403 1808 Fax 0207 378 8150

Sanofi Winthrop Medicare 01483 505515 Fax 01483 554810

Schein Henry Rexodent 0208 235 5005 Fax 0208 235 5010

Siedent 01932 577072

Sierex Dental Equipment Ltd 01922 31217 Fax 01922 30541

Skillbond plc 01494 448474 Fax 01494 461765

Takara Belmont (UK) Ltd 0207 515 0333 Fax 0207 987 3596

Tricodent Ltd 01444 247752 Fax 01444 870640

Market Research: The Medical Engineering Industry

Unirose Medical Ltd 0208 848 1499 Fax 0208 848 7230
White SS Manufacturing Ltd 01452 307171 Fax 01452 300799
WHW Plastics 01482 329154 Fax 01482 217140
Williams Dental 0151 920 3536 Fax 0151 928 8353

Diagnostic Equipment

[Access Drug Tests UK 01405 862 898 Fax 01405 862 898](#)
[Actamed Ltd 01924 200550 Fax 01924 200518](#)
[Alaris 01256 474455 Fax 01256 330860](#)
[APC Cardiovascular Ltd +44 \(0\)1270 216142 Fax +44 \(0\)1270 216251](#)
[Artemis Medical Ltd 01322 628877 Fax 01322 628878](#)
Ashfield Medical Systems Ltd. 01236 737138 Fax 01236 738503
Axis-Shield 01382 422000 Fax 01382 422088
[Beaver Medical Products Ltd 01604 499427 Fax 01604 492212](#)
BioMedical Instrumentation 0141 945 0707 Fax 0141 945 6080
[Celtic ElectroMedical Tel +44 \(0\)1633 861 772 Fax +44 \(0\)1633 861 772](#)
[Charter Kontron Limited 01908 646070 Fax 01908 646030](#)
Cheltenham Medical Co. 01242 245762 Fax 01245 577229
Cogent Diagnostics 0131 445 7111 Fax 0131 445 7112
Dantec Electronics Ltd 01275 375333 Fax 01275 375336
[Datex Ohmeda 01707 263570 Fax 01707 260065](#)
Diagnostic Scotland 01698 351161 Fax 01698 359376
Dynamic Imaging Ltd 01506 415282 Fax 01506 410603
E G & G Astrophysics 01494 451661 Fax 01494 452425
Eclipse Creative Solutions 01491 614151 Fax 01491 614113
Ectron Ltd 01462 682124 Fax 01462 481463
FSM Technologies Ltd. 0141 945 6200 Fax 0141 945 3323
HD Supplies 01296 431920 Fax 01296 392121
Industrial & Medical Electronics 0121 523 5494 Fax 0121 523 5494
Inverness Medical Ltd. 01463 724600 Fax 01463 724601
Morgan Automation Ltd 01730 895900 Fax 01730 895922
Nihon Kohden 0208 814 2333 Fax 0208 814 2666
[Norlite Medical Ltd 01224 573582 Fax 01224 572436](#)
Nuclear Diagnostics 01474 328728 Fax 01474 328718
Oakfield Instruments Ltd 01865 882532 Fax 01865 883970
Omega Diagnostics Ltd. 01259 217315 Fax 01259 723251
Ortho-Clinical Diagnostics 01494 431717 Fax 01494 431165
Park Medical Systems 01252 376737 Fax 01252 376644
Peacocks Medical Group Ltd 0191 232 9917 Fax 0191 230 0767
[Philips Medical Systems 01737 230400 Fax 01737 230401](#)
Psychiatric Diagnostics Ltd 0044 1463 667331 Fax 0044 1463 667310
[Quantase Ltd. 01738 444102 Fax 01738 440422](#)
[SIMS Graseby 01923 246434 Fax 01923 231595](#)
Sonotron Ltd 01234 340881 Fax 01234 266261
Vitalograph Ltd 01280 827120 Fax 01280 823302
[Welch Allyn \(UK\) Ltd 01296 682140 Fax 01296 682104](#)
[White Medical 01788 553904 Fax 01788 560820](#)

Diathermy

Market Research: The Medical Engineering Industry

Baker Thompson 0208 683 1103 Fax 0208 683 1105
[ERBE 0113 253 0333 Fax 0113 253 2733](#)
[Eschmann \(Sims Medical\) 01903 753322 Fax 01903 766793](#)
[Gyrus Medical Ltd 01628 535800 Fax 01628 535801](#)
Phoenix Surgical Instruments Ltd 01920 871429 Fax 01920 871429
[Ross Electro-Medical Ltd. 01747 861812 Fax 01747 861812](#)

Endoscopy Equipment

Endoscopic Manufacturing & Service Ltd 0208 896 1002
Ethicon Endo-Surgery 0800 864060 Fax 01344 864122
Expanded Optics Ltd 0208 441 2283 Fax 0208 449 6143
Karl Storz Endoscopy (UK) Ltd. 01382 647500 Fax 01382 644999
Keymed Medical & Industrial Equipment 01702 616333 Fax 01702 465677
[Olympus Optical Co. \(UK\) Ltd 0207 253 2772 Fax 0207 251 6330](#)
[RB Endoscopy Ltd 0207 251 6494 Fax 0207 253 7585](#)
[Sigmacon \(U.K.\) Ltd. 0208 950 9501 Fax 0208 9509199](#)

Ergonomic

[Aquarius Back Care +44 \(0\)117 965 8555 Fax +44 \(0\)117 965 8444](#)
[MEDesign Ltd +44 \(0\)1704 542373 Fax +44 \(0\)1704 545214](#)

Fibre Optics

Codman Ltd 01344 864030 Fax 01344 864031
Eurosurigical Ltd 01483 456007 Fax 01483 456008

Haemodialysis Equipment

Gambro Ltd 01689 836121 Fax 01689 833957
Haemonetics (UK) Ltd. 01698 819700 Fax 01698 811811
latros 01382 562111 Fax 01382 562583

Hearing Aids

[GM Instruments Ltd. 01294 554664 Fax 01294 551154](#)
Medtex Ltd 0121 565 1910 Fax 0121 588 1398
Nobel Biocare (UK) Ltd 01895 430650 Fax 01895 430636
Oticon Ltd 01698 283363 Fax 01698 284308

Humidifiers

[Fisher & Paykel Healthcare 01628 626136 Fax 01628 626146](#)
[JS Humidifiers plc +44 \(0\)1903 858601 Fax +44 \(0\)1903 850345](#)

Incubators

[Datex Ohmeda 01707 263570 Fax 01707 260065](#)
[Draeger Medical 01442 213542 Fax 01442 240327](#)
[Hill-Rom Airshields 01530 411333 Fax 01530 411555](#)

Market Research: The Medical Engineering Industry

[Seward Ltd 020 8365 4100 Fax 020 8365 3999](#)

Infusion Equipment

Abbot Laboratories Ltd 01795 580099 Fax 01795 593335

[Actamed Ltd 01924 200550 Fax 01924 200518](#)

[Alaris 01256 474455 Fax 01256 330860](#)

[Arcomedical Infusion Ltd 01277 810432 Fax 01277 811967](#)

[Baxter Healthcare Ltd 01635 206000](#)

CeNes Drug Delivery Ltd. 01294 848484 Fax 01294 848486

MW Encap Ltd. 01506 416881 Fax 01506 416882

[New Medical Technology Ltd. 01506 445000 Fax 01506 430444](#)

[Nutricia Clinical Care 01225 768381 Fax 01225 768847](#)

[SIMS Graseby 01923 246434 Fax 01923 231595](#)

[Zimed 01745 585770 Fax 01745 585880](#)

Instrument Cleaning

[Andersen Caledonia 01698 844476 Fax 01698 8444481](#)

[Medisafe UK Ltd 01279 461641 Fax 01279 461643](#)

Laboratory Equipment

Adam Equipment Ltd 01908 274545 Fax 01908 641339

[Andersen Caledonia 01698 844476 Fax 01698 8444481](#)

Ashfield Medical Systems Ltd. 01236 737138 Fax 01236 738503

Assab Ltd 0141 425 1133 Fax 0141 425 1155

Corning Costar (UK) Ltd 01494 684700 Fax 01494 464891

Dynex Technologies Ltd 01403 783381 Fax 01403 784397

E & I (Selsdon) Ltd 0208 657 9169 Fax 0208 657 3970

Eurogenetics Ltd 0208 296 8800 Fax 0208 296 9039

Gulfex Medical Supplies 01494 675353 Fax 01494 675399

Indent (Equipment) Ltd 01253 838800 Fax 01253 692957

Laboratory Automation Development & Service Ltd.

0141 552 3880 Fax 0141 552 3886

[Medical Engineering Technologies Ltd 01233 649204 Fax \(0\) 870 0562 153](#)

Medicell International Ltd 0207 607 2295 Fax 0207 700 4156

[QED Scientific 01663 735494 Fax 01663 732744](#)

[Scotia Glass Technology 01786 473305 Fax 01786 446995](#)

Lamp Suppliers

[Hospital Lamp Supplies \(Hybec\) 0116 235 8818 Fax 0116 235 8810](#)

Light Support Ltd

Market Research: The Medical Engineering Industry

[+44 \(0\)1628 762676](tel:+441628762676) Fax [+44 \(0\)1628 762678](tel:+441628762678)

Laser Eye Protection

[AG Electro Optics 01829 733305](tel:01829733305) Fax [01829 733679](tel:01829733679)

Laser Doppler

[Moor Instruments Ltd +44 \(0\)297 35715](tel:+44129735715) Fax [+44 \(0\)297 35716](tel:+44129735716)

Medical & Surgical Suppliers

[Actamed Ltd 01924 200550](tel:01924200550) Fax [01924 200518](tel:01924200518)
[Biomedicalworld.com \(714\) 389-2484](tel:7143892484) Fax [\(714\) 389-2485](tel:7143892485)
[Central Healthcare \(Midlands\) Ltd. 01543 467 407](tel:01543467407) Fax [01543 469 741](tel:01543469741)
[Central Medical Supplies Ltd 01538 399541](tel:01538399541) Fax [01538 399572](tel:01538399572)
[Don & Low Nonwovens Ltd 01307 452200](tel:01307452200) Fax [01307 452610](tel:01307452610)
[Ecosse Hospital Products Ltd. +44 \(0\)1980 843666](tel:+441980843666) Fax [+44\(0\)1980 843555](tel:+441980843555)
[Ethicon Ltd. 0131 453 5555](tel:01314535555) Fax [0131 453 6011](tel:01314536011)
[Europa-Med Ltd. 020 8673 7073](tel:02086737073) Fax [020 8673 0570](tel:02086730570)
[Fermentech Medical Ltd. 0131 449 5055](tel:01314495055) Fax [0131 449 7676](tel:01314497676)
[Frank Sammeroff Ltd. 0141 881 5701](tel:01418815701) Fax [0141 881 4919](tel:01418814919)
[Iatros 01382 562111](tel:01382562111) Fax [01382 562583](tel:01382562583)
[Kays Medical 0151 207 5117](tel:01512075117) Fax [0151 207 3384](tel:01512073384)
[Lime Bank Products Ltd 0161 832 2091](tel:01618322091) Fax [0161 832 2096](tel:01618322096)
[Lojigma International Ltd 01383 822003](tel:01383822003) Fax [01383 822007](tel:01383822007)
[medi UK Ltd. 01432 351682](tel:01432351682) Fax [01432 342383](tel:01432342383)
[N.H.S. Edinburgh 0131 441 6061](tel:01314416061) Fax [0131 441 5117](tel:01314415117)
[RFO Medical Co. Ltd 020 8871 5216](tel:02088715216) Fax [020 8874 0272](tel:02088740272)
[Siam InterMagnate Co Ltd 662-326-9519](tel:6623269519) Fax [662-326-9609](tel:6623269609)
[Sterimedix Limited +44 \(0\)1527 501480](tel:+441527501480) Fax [+44 \(0\)1527 501491](tel:+441527501491)
[Techbase Medical 01482 226 111](tel:01482226111) Fax [01482 226 130](tel:01482226130)
[Wright Cottrell & Co. 01382 833866](tel:01382833866)

Medical Gas & Equipment

[Amico Corporation 905-764-0800](tel:9057640800) Fax [905-764-0862](tel:9057640862)
[Bedfont Scientific Ltd 01634 375614](tel:01634375614) Fax [01634 378980](tel:01634378980)
[BOC Ltd +44\(0\) 1483 579857](tel:+441483579857)
[BPG Products Ltd 0116 276 3535](tel:01162763535) Fax [0116 276 2001](tel:01162762001)
[Datex Ohmeda 01707 263570](tel:01707263570) Fax [01707 260065](tel:01707260065)
[East Healthcare Ltd 01235 547060](tel:01235547060) Fax [01235 547061](tel:01235547061)
[E & B Gas Control Co. 01474 813416](tel:01474813416) Fax [01474 812185](tel:01474812185)
[Ferno \(UK\) Ltd. +44 \(0\)1274 851999](tel:+441274851999) Fax [+44 \(0\)1274 851111](tel:+441274851111)
[GCE \(Gas Control Systems\) Ltd 01695 714474](tel:01695714474) Fax [01695 509254](tel:01695509254)
[Linde Gas UK Ltd 0208 555 5544](tel:02085555544) Fax [0208 519 8627](tel:02085198627)

Market Research: The Medical Engineering Industry

[Oxylitre Ltd 0161 872 6322](#)

Medical Lasers

[AG Electro Optics 01829 733305 Fax 01829 733679](#)

[Coherent Medical Group 01223 420501 Fax 01223 420073](#)

[Laserscope \(UK\) Ltd 01633 838081 Fax 01633 838161](#)

[Medical Laser Technologies Ltd 01383 411555 Fax 01383 411666](#)

[Moor Instruments Ltd. 01297 35715 Fax 01297 35716](#)

Mortuary Equipment

[Cox Surgical 0208 668 2131 Fax 0208 668 4196](#)

[Leec Ltd 0115 961 6222 Fax 0115 961 6680](#)

Nebulisers

[Devilbiss 01384 446688 Fax 01384 446601](#)

[Henleys Medical 01707 333164](#)

[Medic Aid 01243 846111](#)

[N.H.S. Edinburgh 0131 441 6061 Fax 0131 441 5117](#)

[Norlite Medical Ltd 01358 742878](#)

Nuclear Medicine

[Park Medical Systems \(UK\) Ltd 01252376737 Fax 01252 376644](#)

[Philips Medical Systems 01737 230400 Fax 01737 230401](#)

Obstetric Equipment

[Medela Inc. +1 815 363 1166 Fax +1 363 1246](#)

[NMT - Spembly 01264 345700 Fax 01264 332113](#)

[Oxford \(Sonicaid\) Instruments 01235 533433 Fax 01235 534465](#)

[Philips Medical Systems 01737 230400 Fax 01737 230401](#)

[Saharan Trading Co. Ltd 01788 543771 Fax 01788 540120](#)

[Scala Impex Ltd 0208 459 1810 Fax 0208 459 3416](#)

Ophthalmic Equipment

[Beckett Instruments 01268 773653 Fax 01268 745697](#)

[BID Instruments Ltd 01224 641166 Fax 01224 641166](#)

[Birmingham Optical Group 0121 4422222 Fax 0121 4499993](#)

[Carleton Optical Equipment Ltd 01895 231331 Fax 01895 252869](#)

[Carl Zeiss 01707 331144 Fax 01707 373210](#)

[Clement Clarke 01279 414969 Fax 01279 635232](#)

[Dixey Instruments 01323 449444 Fax 01323 4421164](#)

[Fermentech Medical Ltd. 0131 449 5055 Fax 0131 449 7676](#)

[Jenoptic \(UK\) Ltd 020 8953 1688 Fax 020 8953 9456](#)

[Osbourne & Simmons Ltd. 0207 2523951 Fax 0207 2312481](#)

[Pilkington Optronics 0141 440 4000](#)

[SB Optical Ltd. 01290 551339 Fax 01290552635](#)

[Spectrum Ophthalmics 01625 618816 Fax 01625 619959](#)

Market Research: The Medical Engineering Industry

[Sterimedix Limited +44 \(0\)1527 501480 Fax +44 \(0\)1527 501491](#)
Takara Belmont (UK) Ltd 0207 515 0333 Fax 0207 987 3596
Tayside Optical Technology Ltd. 01382 833022 Fax 01382 833824
Visitec Ltd 01789 490909 Fax 01789 490511
[Welch Allyn \(UK\) Ltd 01296 682140 Fax 01296 682104](#)

Orthopaedic Equipment

[Advance Seating Designs 0208 961 4515](#)
[BF WORLD Co. Ltd. 85-51-517-2527 Fax 82-51-517-8827](#)
Buchanan Orthotics Ltd. 0141 221 9997 Fax 0141 221 1345
Clinical Engineering Consultants 01483 894568 Fax 01483 894576
[DePuy International Ltd. 0113 2700461 Fax 0113 2724101](#)
Gilbey Orthopaedic Footwear 0141 946 4782 Fax 0141 946 6664
Central Medical Equipment Ltd 0115 9390949 Fax 0115 9393102
Lewis Stuart Ltd. 01224 630663 Fax 01224 631908
[MEDesign Ltd +44 \(0\)1704 542373 Fax +44 \(0\)1704 545214](#)
ORTHOSONICS LTD. 973-509-8385 UK +44 (0)1364 652426
Otto Bock (UK) Ltd 01784 744900 Fax 01784 744901
Relief Orthotics Ltd. 01236 767759 Fax 01236 766927
Saharan Trading Co. Ltd 01788 543771 Fax 01788 540120
[Shrewsbury Medical 01743 761847 Fax 01743 761947](#)
Summit Medical Ltd +44 (0)1451 821311 Fax +44 (0)1451 821092
Theraplay Ltd 0141 876 9177 Fax 0141 876 9039
Thompson Wheelchairs Ltd. 01698 825900 Fax 0141 647 7906
W Munro (Rehab) Ltd. 0141 952 2323 Fax 0141 952 3434

Orthopaedic Implants

Aesculap Ltd 0114 225 9000 Fax 0114 225 9111
Cochlear (UK) Ltd 0207 231 6323 Fax 0207 231 3371
Corin Medical Ltd 01285 659866 Fax 01285 658960
De Puy International Ltd 0113 270 0461 Fax 0113 272 4101
Howmedica International Ltd 0208 896 7600 Fax 0208 896 7800
McKenna Precision Castings Ltd 01909 550290 Fax 01909 550285
Stratec Medical 01707 332212 Fax 01707 338504

Oxygen Equipment

BOC Ltd 01483 579857 Fax 01483 505211
[BPR Medical Ltd. 01623 628281 Fax 01623 826289](#)
East Healthcare (Penlon Ltd) 01235 547060 Fax 01235 547061
[Ferno \(UK\) Ltd. +44 \(0\)1274 851999 Fax +44 \(0\)1274 851111](#)
[Oxylitre Ltd 0161 872 6322](#)
SENSORtec 01623 628281 Fax 01623 628289
SOS Products 0161 748 4190 Fax 0161 746 8359

Patient Monitoring

[Actamed Ltd 01924 200550 Fax 01924 200518](#)
[Aortech International plc 01698 746699 Fax 01698748474](#)

Market Research: The Medical Engineering Industry

[APC Cardiovascular Ltd +44 \(0\)1270 216142 Fax +44 \(0\)1270 216251](#)
[Artemis Medical Ltd 01322 628877 Fax 01322 628878](#)
[Beaver Medical Products Ltd 01604 499427 Fax 01604 492212](#)
[Caledonian Medical Ltd. 01698 845511 Fax 01698 845456](#)
[Celtic ElectroMedical +44 \(0\)1633 861 772 Fax +44 \(0\)1633 861 772](#)
[Charter - Kontron 01908 646070 Fax 01908 646030](#)
[Critikon 01256 419000 Fax 01256 419001](#)
[Datascope Medical Co. Ltd 01480 423600 Fax 01480 423638](#)
[Datex Ohmeda 01707 263570 Fax 01707 260065](#)
[Eden Medical 0131 440 6500 Fax 0131 440 6502](#)
[Elcomatic Ltd. 0141 881 5825 Fax 0141 881 5828](#)
[Ellis Cohen 0141 423 7011 Fax 0141 401 0486](#)
[FSM Technologies Ltd. 0141 945 6200 Fax 0141 945 3323](#)
[Gaeltec Ltd. 01470 521385 Fax 01470 521369](#)
[GM Instruments Ltd. 01294 554664 Fax 01294 551154](#)
[Johnson & Johnson Medical Ltd 0800 864 060](#)
[Marquette Hellige 01536 316200 Fax 01536 316205](#)
[Nellcor Puritan Bennett 01869 322700 Fax 01869 321890](#)
[Norlite Medical Ltd 01224 573582 Fax 01224 572436](#)
[Philips Medical Systems 01737 230400 Fax 01737 230401](#)
[Plade Ltd. 0141 881 8241 Fax 0141 881 8143](#)
[Reynolds Medical 01992 507700 Fax 01992 501213](#)
[R L Dolby & Co. Ltd 01786 446640 Fax 01786 446630](#)
[SIMS Graseby 01923 246434 Fax 01923 231595](#)
[Space Labs Medical 0118 944 8411 Fax 0118 944 8006](#)
[Strathkelvin Instruments Ltd. 0141 576 5080 Fax 0141 576 5081](#)
[Uniplex \(UK\) Ltd 0114 272 6858 Fax 0114 272 7288](#)
[Welch Allyn \(UK\) Ltd 01296 682140 Fax 01296 682104](#)
[White Medical 01788 553904 Fax 01788 560820](#)

Patient Warmers

[Actamed Ltd 01924 200550 Fax 01924 200518](#)
[Electro Concept Medical +33 555 53 32 40 Fax +33 555 56 32 41](#)
[JMW Medical Ltd 0131 448 0205 Fax 0131 448 0208](#)
[KanMed AB +46 \(0\)8-83 96 00 Fax +46 \(0\)8-83 38 60](#)

Physiotherapy Equipment

[Central Medical Equipment Ltd 0115 9390949 Fax 0115 9393102](#)
[DMI Medical Ltd 01942 238259 Fax 01942 498491](#)
[Duffield Medical 01706 830086 Fax 01706 830324](#)
[EME Services 0161 748 5660 Fax 0161 748 5668](#)
[MEDesign Ltd +44 \(0\)1704 542373 Fax +44 \(0\)1704 545214](#)
[Medipost Ltd 0161 678 0233 Fax 0161 627 4401](#)
[NMT Spembly Medical 01264 345700 Fax 01264 332113](#)
[Nomeq Ltd 01905 795005 Fax 01905 796655](#)
[Norlite Medical Ltd 01224 573582 Fax 01224 572436](#)
[Physio Med Services 01457 860444 Fax 01457 860555](#)
[Shrewsbury Medical Ltd 01743 761847 Fax 01743 761947](#)
[Sidhil Care Ltd 01422 363447 Fax 01422 344270](#)
[Trimilin \(UK\) Ltd 01243 784488 Fax 01243 780878](#)

Market Research: The Medical Engineering Industry

[Uniphy International.BV+33 \(0\)499 491 800 Fax +33 \(0\)499 474 734](mailto:Uniphy@uniphy.nl)

Plaster Saws

DeSouter Medical 01923 270222

Prototyping

[Amalgam +44 \(0\)117 924 9596 Fax +44 \(0\)117 923 2727](mailto:Amalgam@amalgam.co.uk)

Radiotherapy Equipment

Park Medical Systems (UK) Ltd 01252 376737 Fax 01252 376644

Respiratory Equipment

[Ambu International A/S +45 4324 0101 Fax +45 4324 0104](mailto:Ambu@ambu.com)
[BREAS Medical Limited +44 1252 731660 Fax +44 121 323 4401](mailto:BREAS@breas.co.uk)
[Devilbiss \(Sunrise\) 01384 446688 Fax 01384446601](mailto:Devilbiss@devilbiss.co.uk)
[Ferno \(UK\) Ltd. +44 \(0\)1274 851999 Fax +44 \(0\)1274 851111](mailto:Ferno@ferno.co.uk)
Ferraris Medical 0208 805 9055 Fax 0208 805 9065
Hyox Systems Ltd 01224 740145 Fax 01224740172
[Mallinckrodt 020 7380 9420](mailto:Mallinckrodt@mallinckrodt.co.uk)
[Medic Aid 01243 846111 Fax 01243 846100](mailto:MedicAid@medicaid.co.uk)
[New Tech Associates 201-461-0565 Fax 201-461-0811](mailto:NewTech@newtech.co.uk)
[N.H.S. Edinburgh 0131 441 6061 Fax 0131 441 5117](mailto:NHS@nhs.uk)
[Norlite Medical Ltd 01224 573582 Fax 01224 572436](mailto:Norlite@norlite.co.uk)

Resuscitation Equipment

[Ambu International A/S +45 4324 0101 Fax +45 4324 0104](mailto:Ambu@ambu.com)
[Cardiac Services Ltd 01232 669000 Fax 01232 687100](mailto:Cardiac@cardiac.co.uk)
[Ferno \(UK\) Ltd. +44 \(0\)1274 851999 Fax +44 \(0\)1274 851111](mailto:Ferno@ferno.co.uk)
[Laerdal Medical Ltd 01689 876634 Fax 01689 873800](mailto:Laerdal@laerdal.co.uk)
Medisco Medical Systems 01793 692781 Fax 01793 491688
[New Tech Associates 201-461-0565 Fax 201-461-0811](mailto:NewTech@newtech.co.uk)
[Philips Medical Systems 01737 230400 Fax 01737 230401](mailto:Philips@philips.co.uk)
[Physio Control \(UK\) Ltd 01256 782727 Fax 01256 782728](mailto:Physio@physio.co.uk)
[Seward Ltd 020 8365 4100 Fax 020 8365 3999](mailto:Seward@seward.co.uk)
Sims pneuPac Ltd 01582 453303 Fax 01582 453103

Scales

Seca Ltd 0121 643 9349

Sphygmomanometers

A C Cossor & Son (Surgical) Ltd +44 (0)208 800 1172
Navrish Ltd 0208 364 8363 Fax 0208 441 6813

Suction Equipment

East Healthcare (Penlon Ltd) 01235 547060 Fax 01235 547061
[Ferno \(UK\) Ltd. +44 \(0\)1274 851999 Fax +44 \(0\)1274 851111](#)
[Laerdal Medical Ltd 01689 876634 Fax 01689 873800](#)
[Oxylitre Ltd 0161 872 6322](#)
[Seward Ltd 0208 365 4100 Fax 0208 365 3999](#)
VaxSax Ltd 01752 337000 Fax 01752 337600

Surgical Instruments

[Actamed Ltd 01924 200550 Fax 01924 200518](#)
Asclection - Meditech 01383 411555 Fax 01383 411666
Autogenics Europe Ltd 0141 946 4488 Fax 0141 946 9333
Auto Suture Co (UK) Ltd 01344 627721 Fax 01344 746506
B&H Surgical Instrument Makers 0208 368 1616 Fax 0208 368 0243
BDF Healthcare 01465 714848 Fax 01465 713857
Bien Air (UK) Ltd 01306 711303 Fax 01306 711444
Bignell Surgical Instruments Ltd 01903 715751 Fax 01903 731242
BioMereux UK Ltd 01256 461881 Fax 01256 816863
BioSil 01236 780780 Fax 01236 781234
[Bolton Surgical +44\(0\)114 234 1252 Fax +44\(0\)114 285 3106](#)
[BSZ Surgico 0092.432.580548 Fax: 0092.432.582782](#)
Bullen Healthcare Group 0151 207 6995 Fax 0151 207 0839
C. Bolter Ltd 01732 457010 Fax 01732 740904
[Codman Ltd 01344 864030 Fax 01344 864031](#)
Cremascoli Fry Ortho Ltd 01483 721404 Fax 01483 755282
[DePuy International Ltd. 0113 2700461 Fax 0113 2724101](#)
E&I(Selsdon)Ltd 0208 657 9169 Fax 0208 6573970
Eden Medical 0131 440 6500 Fax 0131 440 6502
Ethicon Ltd. 0131 453 5555 Fax 0131 453 6011
Femcare Ltd 0115 978 6322 Fax 0115 942 0234
[Frank Sammeroff Ltd. 0141 881 5701 Fax 0141 881 4919](#)
ICL Ltd. 0141 332 1331 Fax 0141 332 3129
Indent (Equipment) Ltd 01253 838800 Fax 01253 692657
Kendal Camp Orthopaedic 0121 451 3016 Fax 0121 433 3016
Medical Instrumentation 01382 480900 Fax 01382 730131
[Mediplus Ltd 01494 551200 Fax 01494 536333](#)
[Meditech Systems Ltd 01258 471770 Fax 01258 471772](#)
Mercian Surgical Supply Co Ltd. 0121 429 1133 Fax 0121 429 4983
NMT Spembly Medical 01264 345700 Fax 01264 332113
[Pak Dicklas Impex 00-92-432-551189 Fax 00-92-555176](#)
Prima Instrument Co. Ltd 01932 349300 Fax 01932 336225
[ReMes Biomedical Ltd. 0141 330 3238 Fax 0140 330 3241](#)
S Murray & Co. Ltd 01483 740099 Fax 01483 724462
Saharan Trading Co. Ltd 01788 543771 Fax 01788 540120
Scala Impex Ltd 0208 459 1810 Fax 0208 459 3416
[Serrations 01246 456595 fax 01246 453377](#)
[Siam InterMagne Co Ltd 662-326-9519 Fax 662-326-9609](#)
[Sterimedix Limited +44 \(0\)1527 501480 Fax +44 \(0\)1527 501491](#)
[Stryker UK 01635 262400 Fax 01635 580300](#)
Summit Medical Ltd +44 (0)1451 821311 Fax +44 (0)1451 821092

Market Research: The Medical Engineering Industry

[Surgical Instrument Group Holdings Ltd. 0208 683 1103 Fax 0208 1105](#)

[Swann - Morton 0114 234 4231 Fax 0114 231 4966](#)

[Techbase Medical 01482 226 111 Fax 01482 226 130](#)

[Unirose Medical Ltd 0208 848 1499 Fax 0208 848 7230](#)

[UltraMed Medical Products 0870 765 8000 Fax 0870 765 9000](#)

[Zygomatics Ltd. 0141 578 2295 Fax 0141 775 0604](#)

Test Equipment

[BC Group](#)

[Biomedicalworld.com \(714\) 389-2484 Fax \(714\) 389-2485](#)

[Ultramedic Ltd. 0151 228 0354 Fax 0151 2521673](#)

Theatre Equipment

[Multiplex Contracts Ltd. 01663 764845 Fax 01663 766042](#)

[Nikommed Ltd 01489 894422 Fax 01489 893322](#)

[QED Scientific 01663 735494 Fax 01663 732744](#)

[Siam InterMagnet Co Ltd 662-326-9519 Fax 662-326-9609](#)

[Tricommed Surgical Ltd 0208 656 1924 Fax 0208 656 7026](#)

[Video South 01225 461985 Fax 01225 444425](#)

TNS

[Bodyclock Healthcare 0181 532 9595 Fax 0181 532 9551](#)

[Duffield Medical 01706 830086 Fax 01706 830324](#)

[Tenscare Ltd 020 8547 1999 Fax 020 8574 2888](#)

[Uniphy International.BV +33 \(0\)499 491 800 Fax +33 \(0\)499 474 734](#)

Treatment Couches

[Anglo Health Care Ltd 01494 726600 Fax 01494 726655](#)

[Central Medical Equipment Ltd 0115 9390949 Fax 0115 9393102](#)

[Duffield Medical 01706 830086 Fax 01706 830324](#)

[Huntleigh Akron Ltd 01473 749544 Fax 01473 463096](#)

Urology

[Albyn Medical 01349 862388 Fax 01349 864146](#)

[Dantec Electronics Ltd 01275 375333 Fax 01275 375336](#)

[Lewis Medical Ltd. 020 8360 9176 Fax 020 8360 7273](#)

Ultrasound Equipment

[BCF Technology Ltd 01506 460023 Fax 01506 460045](#)

[Diagnostic Sonar Ltd. 01506 411877 Fax 01506 412410](#)

[GE Ultrasound 01234 340881 Fax 01234 26261](#)

[NMT Spembly Medical 01264 345700 Fax 01264 332113](#)

[Philips Medical Systems 01737 230400 Fax 01737 230401](#)

[Pie Data UK Ltd 01293 510231 Fax 01293 510234](#)

[Oxford Instruments 01235 533433 Fax 01235 534465](#)

Market Research: The Medical Engineering Industry

[WS Rothband & Co Ltd 01706 830086 Fax 01706 830324](#)
[Scimed Ltd 0117 958 3754 Fax 0117 958 4089](#)
[Siemens Medical Engineering 01344 396439 Fax 01344 396496](#)
[Shrewsbury Medical 01743 761847 Fax 01743 761947](#)
[SRA Developments Ltd 01364 652426 Fax 01364 653589](#)
[Toshiba Medical Systems 01293 653700 Fax 01293 560791](#)
[Vingmed GE Ultrasound](#)
[Uniphy International.BV +33 \(0\)499 491 800 Fax +33 \(0\)499 474 734](#)

Ventilators

[BREAS Medical Limited +44 1252 731660 Fax +44 121 323 4401](#)
[Ferno \(UK\) Ltd. +44 \(0\)1274 851999 Fax +44 \(0\)1274 851111](#)
[New Tech Associates 201-461-0565 Fax 201-461-0811](#)
[Sims pneuPAC Ltd +44 \(0\)1582 430000 Fax +44 \(0\)1582 430001](#)
[SLE Life Support 0208 681 1414 Fax 0208 6498570](#)

X-Ray Equipment

[Apollo Lightbox Company Ltd. 01376 348 343 Fax 01376 552219](#)
[Aura Scientific Ltd 01234 823700 Fax 01506 412801](#)
[B Rosenberg Ltd 01638 713483 Fax 01638 510026](#)
[Claudius Ash 01707 646433 Fax 01707 646429](#)
[Delladene X-Ray Ltd. 01908 610 453 Fax 01525 270677](#)
[Dentoral Ltd 0121 558 6041 Fax 0121 555 5405](#)
[Essex X-Ray & Medical Equip Ltd 01371 875661 Fax 01371 875665](#)
[IGE Medical Systems Ltd 01753 874000 Fax 01753 874477](#)
[Kenex \(Electro Medical\) Ltd 01279 417241 Fax 01279 443749](#)
[Medstone International Ltd 01383 821890 Fax 01383 821877](#)
[Medivance Instruments Ltd 0208 965 2913 Fax 01208 9631270](#)
[Philips Medical Systems 01737 230400 Fax 01737 230401](#)
[Rados Technology Ltd 01635 49429 Fax 01635 37335](#)
[SPS Dental \(Sales\) 01992 787870 Fax 01992 651730](#)
[Surgical Medical Radiological X-Ray Ltd 01253 883282](#)
[Todd Research Ltd 01245 262233 Fax 01245 269409](#)
[WS Rothband & Co Ltd 01706 830086 Fax 01706 830324](#)
[Wolverson X-Ray & Electro Medical Ltd. 01902 637333 Fax 01902 605482](#)
[X-Ograph Imaging Systems Ltd](#)



Monitoring of Transportation Research Phase 1

Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

Market Research: Monitoring of Transportation

Contents

1.	Introduction	3
2.	Literature Review	4
3.	The Law	7
4.	Research- Talking to Companies	8
4.1	PIRA International Ltd	8
4.2	Minolta (UK)	10
4.3	Kraft Foods	10
4.4	Nestle (UK)	12
4.5	Ikea	13
4.6	Oxford Magnet Technology Ltd	15
4.7	Robert Bosch	18
4.8	Compaq Computers	19
4.9	Chambers Medical Care Ltd	20
7.	Conclusions	21
	References	23

Market Research: Monitoring of Transportation

1. Introduction

The objective of this project is to explore how important it is for companies to monitor where and when damage can occur during transportation.

During the transportation and distribution of goods, they can experience shocks, vibration and drops. This can often cause damage to the goods.

By understanding the current level of damage of products during transportation, and the issues relating to this problem, we hope to begin to see if a solution can be developed for industries to try and minimise the risks and costs.

The interest to investigate this area began from a project Eatec carried out for Technology Support Guinness Ltd to monitor pallets of Guinness product on four trips around Europe. Shock, vibration, temperature and humidity were measured during handling and transport. This was measured by using a data logger to record a set number of the maximum shock accelerations for each trip. If the threshold at which damage started to occur could be determined, then appropriate measures could be taken to try and improve the situation.

Kodak also used this method of monitoring of transportation to try and reduce the level of damage they were experiencing in the consignment of Kodak paper. However, they did not put the logger on every trip. Instead they warned all distributing parties that a logger would be placed randomly twice a year, and if it was discovered that a particular party was demonstrating rough handling, that party could risk having the contract taken away from them. This proved to be a useful strategy because the level of damage in the consignment of Kodak paper decreased during that year.

This service might be particularly useful for some companies because different countries have different tolerances to damage. For example, Guinness stated that Russia are more tolerant to damage than Japan. Japan will not tolerate even a scratch or tear on the outer plastic covering.

Market Research: Monitoring of Transportation

Following this, Eatec is interested to see if this service would be a potential growth area and whether there is the demand for this service in industries. Hence, companies from various industries were interviewed using a semi-structured survey to try and gain an exploratory understanding of the current level of damage of products during transportation.

2. Literature Review

Not much literature was found based on tracking devices to monitor transportation and damage analysis. However, a paper was written in 1998, 'Damage analysis on transport packaging' (Hakan Tortensson, 1998)¹. Although the emphasis of the paper paid particular attention to the transportation of dangerous goods and the issue of packaging, additional information was collected regarding the transportation sector's views and experience on goods damaged, which are relevant to our research.

The paper starts by highlighting that there is a considerable concern and need for determining the magnitude and character of the stresses, which occur during the transport of dangerous and non-dangerous goods. Recent evaluations of damage mechanisms focus on handling rather than the mode of transportation (Hakan Tortensson, 1998). This suggests that damage in transportation as a result of bad handling is certainly an issue.

The paper points out that several reports indicate that the most critical part of the transportation chain is the intermediate loading, unloading and transfer handling, but this has not been so well investigated (Nesari and Rezaei, 1997)².

The paper stated that shock and vibration are the main causes of damage. The paper talks about a survey carried out in 1997, which demonstrated the transportation sector's views regarding cargo damage. 20 companies comprising of small (31%), medium size

¹ Hakan Tortensson, 'Damage analysis on transport packaging' received 29 June 1998. Technology, Law and Insurance ISSN 1359-9372. 1999 Taylor & Francis Ltd.

² Nesari, N. and Rezaei, M. (1997) Transportpakanningar (Transportation Stresses, in Swedish), University College of Boras. Taken from the Hakan Tortensson paper.

Market Research: Monitoring of Transportation

(8%) and large enterprises (61%) participated through either a questionnaire or interviews and the company sectors included:

- Manufacture and sales of foodstuff
- Trucks
- Medical equipment
- Steel
- Pressure sensors
- ATM machines
- Furniture
- High tech electrical equipment i.e. Hi-Fi, printers etc.
- Defence material

The cost of cargo damage is reported to be relatively high for printers, furniture and steel sheet. The transportation cost is relatively high for ATM (automatic teller machines; 50% of the price), while other sectors are not more than 10%. Transportation damage as a cause for reclaim is very high for hi-fi equipment (80%), dialysis equipment and furniture (Figures taken from the Hakan Torstensson paper, 1998). These results gives us an idea which sectors Eatec might want to target this service at, as they demonstrate the areas which are likely to experience the highest level of damages during transportation. Although these results were obtained for a different purpose (to improve packaging as an approach to solve the damage problems), it would also be effective to try and find out at which point of the transportation chain that the products are being badly handled and then either remove that stage from the chain to stop, or stop the problem occurring at that point.

Insurance companies also reported their experience in transporting goods. In road or rail transportation, the damage is caused by mechanical factors. Air transportation has moisture as the commonest cause. Bad cargo securing waives insurance coverage and most state that handling is the cause of much damage. If this is the case, then being able to monitor the transportation journey and to pin point where and when damage is likely to have occurred, an insurance company is not able to deny this evidence and a

Market Research: Monitoring of Transportation

claim by reason of bad cargo securing. This gives Eatec another possible aspect to promote the monitoring of transportation service.

The paper reports that the measurement of shock and vibration is made through an accelerometer-amplifier-tape recorder (or analog/digital converter and computer). For simple measurements, which also have the advantage of being unknown to the people in the transportation chain, so called shock recorders may be used (Hakan Torstensson, 1998). This methodology is very similar to Eatec's proposed service and suggests that the issue of damage in relation to handling has already been an issue for some time and companies have set up alternative ways to try and gain damage reduction.

The specification for a shock recorder is given in the table below. This was developed specifically for the purpose of Torstensson's project:

Specification for a shock recorder	
Measurement	Acceleration up to 100 g in three directions, temperature -30°C to +75°C, relative humidity up to 100%
Recording	Maximum levels during more than 5000h, complete time histories during more than 1 min
Triggered	Manually or automatically
Filtering	Selectable
Size	Small enough to be included secretly in packages, lightweight enough not to influence the measurement result
Evaluation	Transfer to computer for further analysis in calculation programs, such as Excel™ or Matlab™

Table 1- Specification for a shock recorder (Taken from Hakan Torstensson, 'Damage analysis on transport packaging' received 29 June 1998. Technology, Law and Insurance ISSN 1359-9372. 1999 Taylor & Francis Ltd.)

The paper concluded that transportation damage and protection against transportation stresses still represent a very great problem. Another interesting concluding point made in the paper was that the knowledge, interest or economical incentives often are missing in those organisations or individuals who can influence the damage pattern. This

Market Research: Monitoring of Transportation

suggests that perhaps it is also a managerial problem in the supply chain, which may have allowed the chain of events of damage.

3. The Law

The Law has set packaging essential requirements, which came into force on 1 January 1999³. There are a number of requirements in the regulation but one that may have some link to our research is:

- Packaging must be minimal subject to safety, hygiene and acceptance for the packed product and for the customer

This may appear to have some problems for certain companies because they may prefer to over pack their products to eliminate any possible chances of damage to the product if it is of a high value. Bigger, heavier products such as furniture or big medical equipment magnets are examples of products which are hard to pack and more prone to damage. Extra cushioning will be required to try and absorb shock for example if a drop was experienced. Due to packaging laws and restrictions, relying on packaging to avoid transportation damage may not be a good long-term solution. This may therefore bring more companies to try and think of alternative ways to prevent transportation damage without spending a fortune on packaging.

³ <http://www.dti.gov.uk/access/guidehh.htm>

Market Research: Monitoring of Transportation

4. Research- Talking to Companies

A variety of companies were interviewed. Effort was made to try and interview at least one company from the different sectors mentioned in Hakan Torstensson's paper (Page 6 of this report) to see if a consistency was found with their research in terms of damage to transportation.

4.1 PIRA International Ltd- Jillian Prebble, Senior Consultant

PIRA is a leading commercial consultancy business, which specialises in the packaging, paper, printing and publishing industries. PIRA has a long history of distribution testing. The service that PIRA provides is slightly different to Eatec's proposed idea. PIRA concentrates on where damage occurred, what caused it and develop appropriate packaging to handle these conditions. The packaging would be tested in their laboratories to ensure that the design could withstand a monitored condition. Their customers for this service are drawn from packaging users across many industry sectors including food, drink, computers, chemicals, photographic, medical equipment, electronic equipment and consumer goods.

Jillian Prebble is the senior consultant for a new project they have been researching for six months following requests from their customers which is, '*Damage in the Supply Chain- Cost and Causes.*'

It seems that the results of this project would be of interest to Eatec. Unfortunately, it is PIRA members only who can have access to the result of the findings. However, Jillian Prebble was happy to participate in the telephone interview.

From the research Prebble carried out, she understood that companies are having a problem with goods getting damaged during transportation. This can be any product and in any sector. The actual package gets damaged, e.g. box dented but usually products get damaged too.

Market Research: Monitoring of Transportation

The kinds of damage experienced include:

- Physical damage: squashed, scuffed and scratched
- Biological/Environmental damage (wet conditions)
- Electrical static discharge damage
- Chemical damage

At the moment, Prebble responded that counterfeiting control is one of the major concerns, which many are concentrating on, and therefore, damage in transportation may not be taken as a priority but the cost will just be absorbed as wastage cost.

The exact figure for damage is unknown because waste figures get lumped together. How companies control or minimise the level of damage is down to the individual company and their budget. Unfortunately, in a long supply chain, damage responsibilities are usually passed upstream and the burden is often placed on the product manufacturers.

If companies need to over package it is usually to try and reduce the risk of transport damage but this method is limited because the government has set regulations to control the level of packaging waste for environmental issues.

Some companies do take out insurance to cover for damages but Prebble stated that it is difficult to apportion the blame in instances where the damage may have occurred in a number of places.

The monitoring of transportation is not a new concept. Prebble said the data recorder mounted onto pallets has been around for at least 5 years, maybe longer. PIRA has been simulating journeys in their test lab for a few years and they also rent out data recorders for companies who wish to pursue the monitoring of transportation further.

Market Research: Monitoring of Transportation

The interview with Prebble proved to be useful as this supported the literature that damage in transportation is certainly a problem. It is not a new concept but a specific amount of expertise is required to analysis the data retrieved from the data logger. Therefore, demand for consultancy service is possible and companies are not promoting 'monitoring of transportation' as a service, which is a good opportunity for Eatec to obtain a lead in the market.

4.2 Minolta (UK)- Colin Watson, Distribution Manager

Minolta create business, photographic and industrial equipment, and are based in Buckinghamshire. It was a short interview with Colin Watson who is responsible for distributing Minolta parts. The company does not have a problem with goods getting damaged during transportation. This is probably due to a shorter supply chain. As Hakan Tortensson suggested in the paper, as the amount of handling increased during the journey, the more likely it is for products to get damaged. In Minolta's case, since the supply chain is relatively short, (they do not export) and have sourced a very good and reliable logistics company, they are not one to have been affected by the damage in transportation problem. They do however import goods and Watson notes that when these are faulty, they just return them under warranty.

This is a good example of a party at the lower end of the supply chain passing the responsibility upstream. Since the product was under warranty, the supplier is obliged to take it back and replace it with a new one for the customer.

4.3 Kraft Foods- Robin Lang, Quality Systems Manager (UK)

Kraft Foods Inc is the second largest food company in the world. Their portfolio of products includes Kenco Coffee, Philadelphia and Dairylea and Terry's Chocolate Orange.

Market Research: Monitoring of Transportation

Steve Cox is the logistics operation manager but referenced Robin Lang as a more appropriate person to discuss damages in transportation.

Lang responded that problem with goods getting damaged during transportation does happen occasionally but this is counted as part of the wastage and shrinkage cost.

The types of damage Kraft Foods experience included crush damage, drop damage and pallet scraped on the side of the vehicle. A damage cost is split between budgets.

Budget 1- Warehouse (transit)

Budget 2- Customer refusal (transit)

Budget 3- Damage packaging (consumer complaint)

In budget 3, damage packaging, this is not just damage in transport, but for example, if Sainsbury's had a complaint from a customer regarding Kraft Foods, then Sainsbury's would just return it to Kraft Foods because the customer was not satisfied.

Approaches have been taken to try and control or minimise the level of damage. For example, if a particular product was constantly damaged, then that would be looked at as a project and monitored. However, it is usually the packaging that gets changed.

Regarding packaging, Lang said that there is always pressure to reduce packaging, and due to this, the company has to accept the damage level. The first requirement is to reduce cost, and second, there is the packaging regulation. Over a certain amount of packaging, a company has to start paying a fee to the recycling firm.

Market Research: Monitoring of Transportation

In the food industry, they tend to look at the packaging to try and minimise the level of damage during packaging. As an estimate, the value of package damage is about 10-15% of sales.

It is not usual for Kraft to take out an insurance policy to recover damages. They would rely on a good logistics company to transport their goods safely.

A monitoring of transportation service would not be as useful to Kraft Foods because the consumer food market are not considered to be high value goods. Instead, the company would look to improve the food packaging.

4.4 Nestle (UK)- Ian Medd, Transport Manager

Nestle is also in the confectionary business and findings given by Ian Medd are similar to Kraft Foods findings.

Nestle experienced little problem with goods getting damaged during transportation. It is usually the outer wrapping, which gets ripped. In terms of damage cost, it would just be accounted for as part of the wastage costs.

Nestle have their own team of packaging technology experts. This is to find new ways of packaging to control or minimise the level of damage. The company has also placed an extreme loading policy and procedure, which describes how goods are to be loaded on trailers. This demonstrates one possible way of trying to minimise handling damage during transportation from the managerial aspect. However, if the supply chain was more complex involving exporting to Europe and worldwide, it would be harder to monitor the transportation process. The company does not receive a significant amount

Market Research: Monitoring of Transportation

of customer complaints and therefore, does not have a major issue of transportation damages.

It seems that for the monitoring service to be of significant use, it requires companies who are exporting goods, which are of a higher value and also who ship bigger, bulky items, which are harder to package. In order to understand if this may be the case, Ikea and Oxford Magnet Technology was interviewed to understand the transportation issues in these areas.

4.5 Ikea- Chris Grant, Distribution Manager & Jimmy Uncles, Warehouse Manager

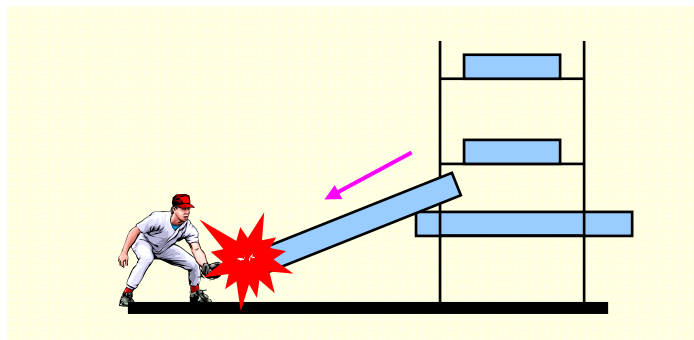
Ikea offers a wide range of home furnishings worldwide. The face-to-face interview was conducted at their warehouse in Bristol, Eastgate Shopping Centre.

Ikea Bristol store is approximately 16,000 square metre and 5,000 square metre external warehouse. Ikea has a serious issue with damage. A vast amount of damage is experienced on trailers and during off loading due to the majority of the Ikea products which are big and bulky, and may not be particularly well packaged or fitted on a right size pallet. The problem is, by the time the products arrive at the store warehouse from the various distribution centres around UK and Europe, damage has already occurred and no one in the distribution chain is owning up to the responsibility of causing damage. Production line can be anywhere in the world and to pinpoint the exact location of damage is difficult. The only monitoring that is currently being carried out is known as the eyeball test. This is literally random checking of the products for damage. It seems that products from Asia experience the most damage. This is because they have to sustain a longer travelling journey by airfreight and by sea. The damage experienced most tends to be mould damage.

Market Research: Monitoring of Transportation

Since Ikea use a third party to carry out home delivery, this is another opportunity where damage is likely to occur as it is more difficult to monitor the handling if it is handled by a sub contracted logistics company.

The managers took us around the warehouse to view some of the damage. The kind of damage experienced is due to manual handling. For example, one product weighed approximately 114 kg and was extremely long. During manual handling, due to the heavy weight of the product, the cardboard packaging was not able to sustain the weight of the product, causing the packaging to rip as the product is being handled. This is known as friction damage.



Weight of product breaks packaging as it is being pulled forward and bangs on floors, shelves, causing friction damage and damages to corners.

The kinds of products that are more prone to damage are wardrobes and anything containing glass and are flat packaged as these experience an immense amount of friction damage. They are not able to over package their products to try and prevent such damage because of environmental issues. Hence, it does seem that a monitoring service would benefit Ikea immensely.

Jimmy Uncles, the warehouse manager stated that approximately 50% of products in the warehouse experience packaging damage and a majority end up in the recovery department. The recovery department is where Ikea warehouse staff try and fix the damage but items where, for example a corner is chipped off, would be beyond repair and it's selling value would decrease from £70 to £10.

Market Research: Monitoring of Transportation

There is no set standard in how handling is carried out during transportation. This is down to the co-worker's competence. It was noticed, however by the managers while they were taking us around the warehouse, that handling attitude by co-workers seemed to be a lot more careful and the manager said that this sort of behaviour is not normal in the usual work environment. This demonstrates that workers tend to treat products with more care if they realise they are being monitored and that they may be held responsible for mishandling of the product.

The interview and viewing of the warehouse was extremely useful in understanding the possible types of damages experienced during transportation and in the warehouse. Upon closing of the interview, Eatec offered a free trial service that would also aid Eatec's marketing if this service is to go ahead. The exercise would be to install a logger onto a pallet and monitor it on a trip from one of Ikea's distribution centres to the store in Bristol and a short report would be produced to demonstrate the information that can be collected from such a service. Eatec now waits for Ikea's response from senior management.

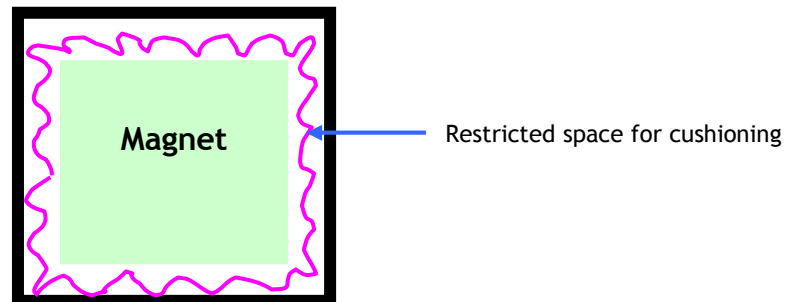
4.6 Oxford Magnet Technology Ltd.- Fiona Smith, Logistics Manager

Oxford Magnet Technology designs and manufactures magnets for the medical diagnostic application of Magnetic Resonance Imaging. Their customers include Siemens Medical, Marconi Medical Systems and Toshiba Medical.

The company experiences a lot of damage during transportation. The sort of damage experience is drop damage which is a major issue for Oxford Magnet because the actual product itself is extremely heavy and a drop can cause damage to the magnet internally, which may not be visible until it is being used at the hospital. Approximately £45-50k worth of damage is experienced per annum and therefore insurance is required for this sort of product in the medical field.

Market Research: Monitoring of Transportation

In order to control transportation damage, Oxford Magnet spend a lot on packaging and also have shock loggers in place. AV mounts are used as cushioning for the packaging but due to restrictions in packaging, monitoring the transportation chain to understand where damage is being caused was an action that had to be done.



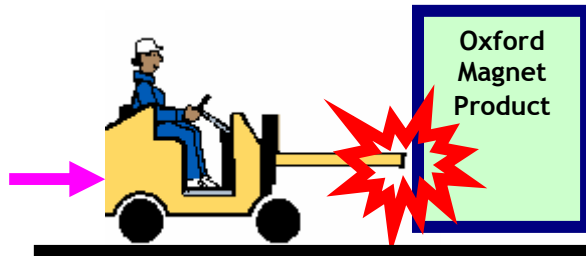
Oxford Magnet assisted Lamerholm Fleming Ltd to produce a shock logger similar to Eatec's monitoring device. The device has similar functions to Eatec's device and cost only £500 per device. This would therefore enable Oxford Magnet to have a logger for each product that is being shipped out due to the product's high value. The logger has been designed and used for three years and it comes complete with a software package to analyse data. The loggers have been tried and tested to withstand varying temperature conditions.

This monitoring has been useful for Oxford Magnet because when it comes to insurance claims, the insurance company could not deny their claim given the evidence from the logger. This service proves to be beneficial to firms with extremely high value products and damage to products would result in further cost and time and in this case, hospitals can go down.

With these device, Oxford Magnet was able to see that forklifts caused lots of damage because the forks jammed into the casing when the forklifts were not operated with care.

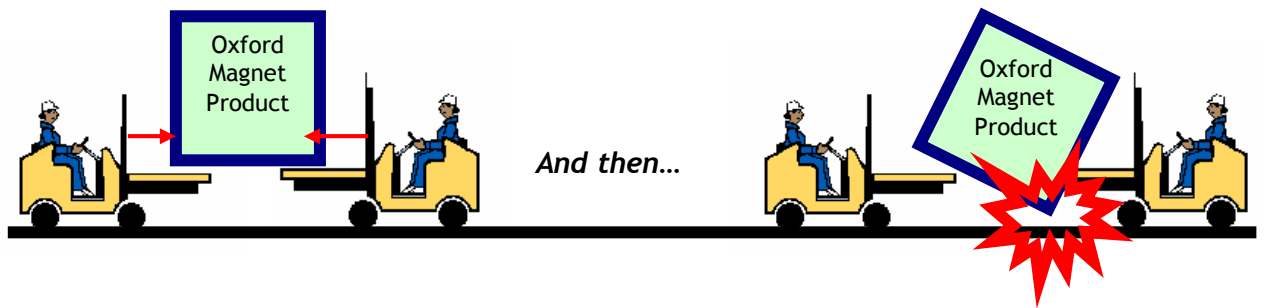
Market Research: Monitoring of Transportation

Scenario One

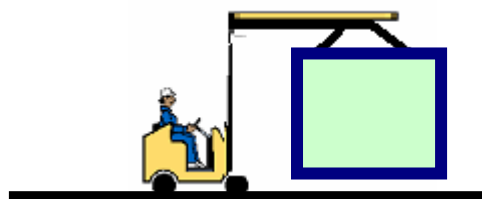


Forklift coming into product at fast speed and accuracy sometimes miscalculated and jams into product

Scenario Two



With this information, Oxford Magnet was able to provide some standards. They abandoned any use of forklifts and insisted that cranes are used instead.



Crane lifting product up instead of using forklifts

The way insurance companies work, a claimant must prove that they have taken care to avoid any possible damage. This can sometimes be difficult for a company who has a long distribution chain and exports all over the world. Therefore, Oxford Magnet found that this device was able to eliminate these insurance specifications. Once the information collected from the logger is given to the insurance company, the insurance

Market Research: Monitoring of Transportation

company hunts down the offender and usually a private investigator is involved to look further into the case. However, it seems that most of the claims are paid by the underwriter but having the information from the logger assists to spread the damage costs amongst various parties.

The other issue that Fiona Smith also noted is the export control. Since Eatec's monitoring device was bought from Dallas Instruments based in the US, the device's country of origin is classed as U.S.A. Therefore, the export or re-export of these products, or transfer of these technologies, is subject to the export laws and regulations of the United States⁴. The scope of the U.S export laws and regulations primarily includes:

- The export of U.S. products or technology from the United States
- The movement of U.S. products or technology outside of the United States
- The movement of non-U.S products or technology that have U.S. content

If Eatec is to expand this monitoring service and more of these US devices are bought, export control may be a possible issue. The shock loggers used by Oxford Magnet designed by Lamerholm Fleming Ltd are designed and built in the UK and will cause less of a problem regarding export and it would also be less costly for Eatec to run the monitoring service.

4.7 Robert Bosch- John Greville, Logistics Manager

Robert Bosch is a large group with a number of products including household appliances, heating systems, lawn and garden products, packaging machinery, power tools, car audio and navigation, automotive equipment, automotive products and automation

⁴ <http://www.hq.nasa.gov/office/codei/nasaecp/Webbbrfg/sld004.htm> and <http://usa.autodesk.com/adsk/index/0,,781062-123112,00.html> [Accessed on 23/07/2002]

Market Research: Monitoring of Transportation

Technology. John Greville is responsible for the latter products of this list, from power tools onwards.

Goods getting damaged during transportation is a problem to the firm. The sorts of damage experienced are drop damages and crush damages due to the forks from forklifts going through the pallets. The company has to over package their goods to try and eliminate these damage problems and the issue has been improving, although it was stated that any damage is an inconvenience to the client because of the area they work in, which is automotive related. Usually parts are required straight away and if they are damaged, this can cause problems further down the chain.

John Greville was unable to provide an in-depth interview but from the following, it is understood that companies dealing with technical equipment such as the automotive industry in this case, cannot afford to have parts getting damaged during transportation and will usually over package products just to save time but not necessarily cost.

4.8 Compaq Computers- Stewart Read, Operations Manager

Compaq computers based in Bristol was interviewed over the telephone. Computers are considered a high value product but rather than laptops getting damaged, it is usually PC components that get damaged during transportation. The sorts of damage experienced are usually ripped or crushed packaging. The heavier components such as servers and monitors are harder to move and are easier to get damaged. It was difficult to estimate the damage costs but if the company raises a claim then they usually get payment.

Compaq subcontract a third party to distribute their goods. Stewart Read did state that it seems damage occurs more often when transportation is overnight. This could be

Market Research: Monitoring of Transportation

because the night shifts are less favourable and therefore, handling performance may decrease because of less care and there is less chance of monitoring taking place. In situations like this, a monitoring device would be useful as an additional exercise to test if there is a difference in handling performance between daytime and nighttime distribution.

4.9 Chambers Medical Care Ltd- Andy Evans, Distribution Manager

Chambers Medical Care is a private company which is a wholesale supplier to the UK National Health Service (N.H.S.), export markets and the UK Medical Procurement Executive of the Ministry of Defence covering an extensive range of products.

This company was interviewed as a comparison with Oxford Magnet, both supplying medical products. Chambers Medical also experience damage to products during distribution but this is not a significant amount and if there is any, they just return it to the manufacturers. The types of goods that experience damage mostly are the circuit boards. This demonstrates that it is not necessarily big bulky items which experience problems. Sometimes, smaller but technical items like circuit boards may also malfunction due to certain shocks and vibration or damage by crush or drop. It's a lot simpler for Chambers Medical because they just return the circuit boards to the original manufacturer, but unless somewhere along the distribution line, the circuit boards are monitored during their travel, it would be hard to identify whether the product was faulty at point of the manufacturers, or during the journey to its destination.

Chambers Medical's way of tackling transportation is to package it very well and admits that they do over package their products but at this stage, this is all they can do to prevent damage during transportation. Since the components are not particularly high value products, it was felt that it may not justify adopting a monitoring service to understand when and where damage may have taken place.

Market Research: Monitoring of Transportation

7. Conclusions

The distribution chain is hardly ever simple and distribution systems can vary enormously. In its simplest form, the chain involves shipment direct from the manufacturer to the customer or end user. In its more complex form, the distribution chain may involve a number of storage and transit locations, including airports and docks, and a variety of transport facilities including aircraft. Because of this, various standards of handling will be experienced during these stages, making it easy for parties to 'pass the blame' if damage is experienced and no evidence can be given as to where and when it occurred.

From the exploratory interviews, damage during transportation is inevitable, almost as if it is expected. However, in some countries, such as Japan, even the slightest tear in the outer plastic layer is not tolerable. There are a number of ways companies are handling these problems. One is to over package it's products, two is to invest in monitoring equipments such as Oxford Magnet technology, or three, save cost and reduce packaging and just bear the cost as part of shrinkage cost of stock.

There is a potential market, but Eatec would need to provide a very well managed and specific marketing promotion to the right kinds of company who would really benefit from this service. These companies may have very high value goods, or it may be that customer satisfaction is extremely important like Ikea, where goods are not particularly costly, but unhappy customers will result in a very bad company reputation.

From this exploratory research, we can conclude that the potential markets to promote the monitoring of transportation service are:

Market Research: Monitoring of Transportation

- Electric equipment (As specified in Hakan Torstensson's paper, i.e. hi-fi, printer)
- Medical equipment (dialysis machines mentioned in the Hakan Torstensson's paper and Oxford Magnet Technology experiences)
- Food and drink shipped to particular countries which are not tolerant to damaged packaging
- Furniture and homeware (such as the IKEA case)
- Specialist equipment which is shipped to places of a significant distance (e.g. Jordan Kent Metering Systems, Wickwar. Probably very sensitive to shocks and vibration during transportation)

Market Research: Monitoring of Transportation

References

Contacts:

Chambers Medical Care Limited- Andy Evans, Distribution Manager. 01264 332172

Compaq Computers Ltd- Stewart Read, Operations Manager. 01454 610684

Ikea- Chris Grant, Distribution Manager.

(Eastgate Shopping Centre, Eastville, Bristol, BS5 6NW)

Kraft Foods- Robin Lang, Logistics Manager. 01242 236101

Minolta (UK) Ltd- Colin Watson, Distribution Manager. 01908 200400

Nestle (UK)- Ian Medd, Transport Manager. 01904 602061

Oxford Magnet technology- Fiona Smith, Logistics Manager. 01865 850322

Mobile 07799438166, fiona.smith@omt.co.uk

PIRA- Jillian Prebble, Senior Consultant. 01372 802144

Robert Bosch- John Greville, Logistics Manager. 01895 838642

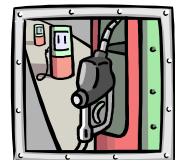
Articles:

Hakan Torstensson, 'Damage analysis on transport packaging' received 29 June 1998.
Technology, Law and Insurance ISSN 1359-9372. 1999 Taylor & Francis Ltd.

Office of External Relations and NASA Export Administrator-
<http://www.hq.nasa.gov/office/codei/nasaecp/Webbrfg/sld004.htm> [Accessed on 23/07/2002]

Autodesk- <http://usa.autodesk.com/adsk/index/0,,781062-123112,00.html>

The Oil and Gas Industry Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

Market Research: The Oil and Gas Industry

Table of Contents

1.	Introducing Oil and Gas- where does it come from?	4
1.1	The Significance of the UK	4
1.2	The Main Players in the Industry	5
1.3	Getting to Grips with the Industry Structure	6
2.	Understanding the relationship between Eatec and Schlumberger	9
3.	A Flavour of the Sectors	12
3.1	Multiphase Separator	12
3.2	Platforms	12
3.3	Valves	13
4.	Operators	14
4.1	Mobil Technology Company uses Flow Simulation	14
4.2	BP Amoco designs a new platform	14
4.3	The Beryl Bravo Platform	15
5.	Contractors	16
6.	Talking to the Industry	17
6.1	Submetrix Ltd.	17
6.2	Burgess-Manning	17
6.3	SeaMark Systems Limited	18
6.4	Bel Valves	19
6.5	Dublok UK Ltd	21
6.6	Valve (Engineering) Services	21
7.	Conclusions	23
	References	24

Market Research: The Oil and Gas Industry

Table of Figures

Figure 1.	Oil company primary activities	4
Figure 2.	Upstream supply	5
Figure 3.	Flow vectors and pressure distribution	9
Figure 4	Flow pathlines in a pressure relief valve cage	10

Market Research: The Oil and Gas Industry

1. Introducing Oil and Gas- where does it come from?

The North Sea has been exploited for Oil and Gas for over 30 years. The fields fall into three main areas: the Southern which are all gas fields, the Central which are both oil and gas, and the Northern which are mostly oil. New areas of the North Atlantic west of Shetland, Cardigan Bay off Wales, and Morecambe Bay in the east Irish sea was opened up in 1995 and the entry into the North Atlantic is part of a worldwide trend in the oil industry to move into frontier areas, areas which were previously untouched¹. This has been led by rapid development of new technology, including seismic equipment, drilling techniques, subsea facilities; floating vessels; tough ice-proof rigs etc. New fields are more profitable than mature fields and companies share prices depend on their constantly acquiring new exploitable reserves (Corporate Watch, 1988).

1.1 The Significance of the UK

There are about 90 countries in the world where oil and gas can be found. The UK only hold about 0.4% of the oil, and 0.5% of the gas but it is responsible for producing 4% of oil production and 3.1% of gas production for the industry. The UK consumes 2.7% of the world's oil, and 3.2% of its gas (by contrast, the US consumes 25% of world oil). These statistics give a rough estimate only and are correct at time of publishing but it suggests that although we do not have a huge amount of oil and gas in its territory, the UK's significance lies in its being a corporate and an intellectual centre for the industry (BP, Statistical Review of World Energy, 1995). The North Sea is also important as a major source of oil and gas for the European market because long distance transportation is expensive.

The UK offshore oil and gas industry nevertheless, continues to maintain a key role in the UK economy, with sales of oil and gas produced in 1994 estimated at £9.5 billion and the sector contributing almost £12 billion to the nation's GDP. In 1996, it was predicted that the level of oil and gas production by volume would exceed that of any previous year. An estimated 300,000 people are directly employed in oil and gas related activities

¹ http://www.corporatewatch.org.uk/publications/oil_gas.html [Accessed on 29/04/02]

Market Research: The Oil and Gas Industry

in the UK, of which 27,300 work offshore. These figures are not expected to fall substantially until 2010 (DTI, The Energy Report, 1995).

1.2 The Main Players in the Industry

The Oil and Gas Industry is one of the richest in the world, with investments in exploration and productions reaching \$111billion in 1998. Investment dropped in 1999 by 22% marking the greatest variation since 1986. Some of the major UK Offshore Operators include: BP, Shell UK, Amoco, Exxon Mobil, British Gas Group and Texaco.

More recently, the North Sea oil and gas producers are stepping up their campaign to overturn a 10% surcharge on their profits, which was unveiled in last month's UK budget (Mathew Jones, 2002). The UK Offshore Operators Association, which represents the 30 largest North Sea licence holders, claims the surcharge will hit oil company earnings by at least £2bn this year. The campaign has come against a backdrop of falling oil and gas production in the North Sea as reserves become depleted. The Department of Trade and Industry has estimated Britain will become a net importer of gas on an annual basis.

In the Financial Times, it noted that in a briefing document sent to MPs and members of the Scottish Parliament that the industry would have to pay at least £6bn in additional tax between now and 2010. It was also quoted that the removal of this cash flow will reduce investments, jobs, oil and gas production, and recovery of remaining reserves and accelerate the point at which the UK commences imports of oil and gas, thus damaging the balance of payments (Mathew Jones, FT. 2002). These changes may have a knock on effect to the industry as a whole and perhaps potential work for Eatec if this sector is targeted for market development. In order to understand how, the industry structure is explored to gain some idea about activities in the oil and gas industry.

Market Research: The Oil and Gas Industry

1.3 Getting to Grips with the Industry Structure

In terms of the overall activities, most of the major companies such as BP, Shell, the extraction of hydrocarbons is only one facet (figure 1).

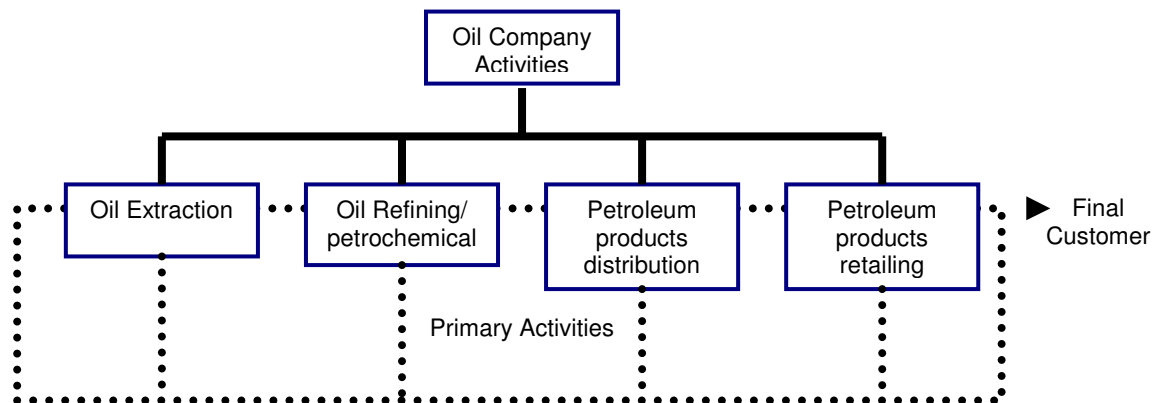


Figure 1. Oil company primary activities (Adapted from N. Slack *et al.*)

Extraction is at the 'upstream' end of the industry. Refining, distribution and retailing are at the 'downstream' end. Figure 2, illustrates many of the supply requirements of the oil companies within their upstream operations (E.Crabtree *et al*)

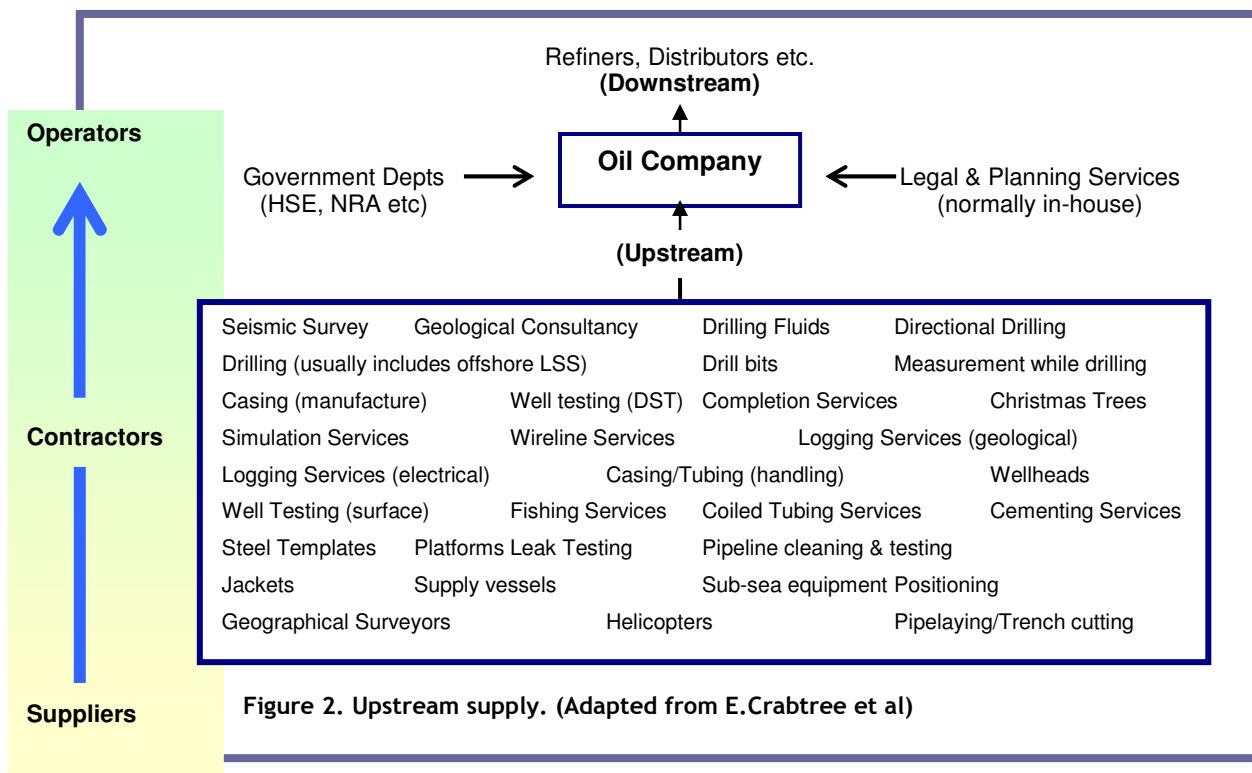


Figure 2. Upstream supply. (Adapted from E.Crabtree *et al*)

Market Research: The Oil and Gas Industry

In this highly subcontracted industry, there are a number of small technology based oil related companies, also known as STBORs grown up around the exploitation of the North Sea reservoirs (D, Krahn. 1994). These companies provide a wide range of products and services for drilling and extraction operations.

There are a number of levels within the industrial network of the oil and gas industry in the North Sea. The key players can be categorized into (figure 2):

- Operators
- Contractors
- Suppliers

The operators are the companies, which both license the oil and gas rights to arrange and take direct legal responsibility for exploiting them (E. Crabtree, 1997). Examples of Operators are huge multinationals such as BP, Shell, Elf and Exxon Mobil.

The contractors include large companies, which contract directly with the operators to arrange and provide services. Examples of contractors in the industry include companies like Schlumberger, Baker Hughes and AMEC. These contractors take responsibility for dealing with most aspects of field operations, including drilling, construction and production, maintenance, logistics and general oil-field support.

The Suppliers falls into two categories. One category supplies basic items such as nuts, bolts and delivery services and the other category is the highly specialised products and services (E. Crabtree). The suppliers in the highly specialised products and services area need to invest in high levels of innovations to meet the needs of the fast-changing, high technology industry. Some are large firms and others belong to the group of STBORs. These suppliers deal directly with contractors and in some cases, deal directly with operators. It is in these two levels, contractors and suppliers where Eatec may consider developing business if this segment is chosen as part of the strategic development.

Market Research: The Oil and Gas Industry

The industrial network in the offshore oil and gas industry includes a wide diversity of players and is particularly complex. There is no common strategy at any level in the industry, which may lead to issues concerning conflict or collaboration. It was suggested in a research (E. Crabtree et al. The Changing Nature of Inter-firm Relationships in the UK Oil and Gas Industry) that personal relationships were extremely important in the oil and gas industry. The article² discusses the changing nature of inter-firm relationships in Great Britain's oil and gas industry. Impact of changes on industrial network and supply relationships of the industry; definition of supply networks; role of specialist supply network in North Sea projects; and mechanisms for purchase and supply (Business Source Premier, University of Bath online database abstract) which can be useful for Eatec to develop an understanding on the inter-firm relationships in the oil and gas industry if the sector is chosen for further development.

² Elisabeth Crabtree, D. Jane Bower & William Keogh. Technology Analysis & Strategic Management, Vol. 9, No. 2, 1999. *Conflict or Collaboration: The Changing Nature of Inter-firm Relationships in the UK Oil and Gas Industry*. Carfax Publishing. Available on University of Bath Electronic Journal Services- Business Source Premier

Market Research: The Oil and Gas Industry

2. Understanding the relationship between Eatec and Schlumberger

Schlumberger provides services to increase the productivity of oil and gas reservoirs, from exploration through field development and managing of the following:

- Surface seismic (WesternGeco)
- Directional drilling and real-time drilling analysis
- Drill bits
- Drilling fluids (M-I)
- Openhole logging
- Cementing and simulation
- Cased hole logging and perforating
- Well completion services and equipment
- Production systems engineering
- Subsea and topside facilities (Syntheseas)
- Well testing
- Well intervention
- Electrical submersible pumps

Eatec is currently working on a number of projects based around Drill bit knowledge for Schlumberger. About 60% of Eatec's resources are based solely for Schlumberger. The amount of experience developed from working together with Schlumberger has resulted in long term trusting relationship and continual work. From this, Eatec has gained expertise knowledge in the drill bit industry and Schlumberger has expressed an interest to protect itself by making arrangements with Eatec not to work with competitors in the same field to avoid exposing specific drill bit knowledge that is unique to Schlumberger only. This type of relationship has been reported in many cases that have been studied³ where the necessary knowledge flows are mediated by long-term relationships between technology suppliers and their clients. And a feature of these relationships that is of central importance is the trust.

³ H. Hakansson (Ed.), *Industrial Technological Developments: A Network Approach* (London, Croom Helm, 1989); H.G. Gemunden & P. Heyedebreck, 'The Influence of Business Strategy on Technological Network Activities',

Market Research: The Oil and Gas Industry

There are two kinds of trust according to Luhmann (1979)⁴: personal trust and institutional trust. Macneil (1987)⁵ explained that institutional trust is generated by adherence to the social norms and that these norms are set up over time in the course of many exchange relations. Where the norms of the industry are unclear, or in a process of rapid evolution, institutional trust is unlikely to be great and personal relationships would become relatively more important (Berger *et al*, 1991)⁶.

This suggests that it is important for Eatec to develop similar kinds of relationship as established with Schlumberger with other potential clients in the industry if this is going to be one of the chosen sectors for Eatec to develop business.

The research carried out by E. Crabtree *et al.*, consisted of two phases. Phase 1 involved consulting the extensive secondary sources of information about companies and the industry, including company reports and publications, trade and general press, industry and professional journals, newsletters and databases, conference proceedings and academic papers. A round of minimally structured interviews with 35 industry experts was also carried out from all levels of the industry to determine the main trends and the main players at all levels of the industry (E. Crabtree *et al*). Phase 2 involved semi-structured interviews with senior executives selected from each of the three levels of the industry, accompanied by an in-depth questionnaire, based on information generated by phase 1.

Phase 1 of the research suggested that personal relationships were extremely important in the oil and gas industry. This issue was further explored during phase 2 and the data confirmed that personal relationships could be very powerful, with many interviewees using the term 'incestuous' when describing the industry. In many instances, it was reported that the decision to award work to a particular company has as much to do with the presence of key individuals who were known, respected and trusted as with the overall reputation of the organisation concerned (E. Crabtree *et al*. 1997).

Research Policy, 24, 1995, pp. 831-850; D.J. Bower & E. Whittaker, 'Global R&D Networks; The case of the Pharmaceutical Industry', *Journal of Industry Studies*, 1, 1993, pp. 50-64.

⁴ N. Luhmann, *Trust and Power* (Chichester, John Wiley, 1979)

⁵ I. R. Macneil, 'Relational Contract Theory as Sociology: A Reply to Professors Lindenberg and de Vos', *Journal of Institutional and Theoretical Economics*, 143, 1987, pp. 279-290

Market Research: The Oil and Gas Industry

Therefore, this report on the oil and gas is restricted to services which are not in direct conflict with Schlumberger's business in the drill bit area and suggests that any future work carried out in the oil and gas industry is dependent on personal relationships already developed or through contacts and references in the industry.

For practical reasons, research on the UK Oil and Gas industry has been reduced down to a few of the vast amount of services and equipments shown on figure 2, although this list is not exhaustive.

⁶ H. Berger *et al.*, 'Understanding the Subcontracting Relationship', paper for the Tenth EGOS Colloquim, Vienna, July 1991.

3. A Flavour of the Sectors

3.1 Multiphase Separator

Multiphase separators are huge pressurised vessels that play a critical role in offshore oil production. The mixture of oil, gas, and water emerging from the ground enters the separator as a high momentum jet and proceeds through a cyclone designed to separate solids from the fluid.

Computer simulation has contributed to increased production in a North Sea oil field by helping to conceive and validate design changes that increased the output of the three-phase separator that was previously a limiting element (Hansen, E. 2001). The separator on the Gullfaks A platform prevented production increases because of an excessive water cut in oil coming out of the separator above a certain production volume. The Engineers suspected that the design of the internals of the separator was to blame, but were limited in evaluating design modifications by high cost and lead time of physical testing as well as scalability concerns. This is where CFD was used by Sintef researchers to analyse velocity, pressure and concentration of multiphase fluid flow within the separator. The insight gained by this analysis made it possible to specify design changes that allowed the production volume to be substantially increased while actually reducing the water cut (Offshore, Sep 2001⁷).

3.2 Platforms

It seems from secondary data that CFD is applied a lot in many activities in the Oil and Gas Industry sector. Since it is an accepted tool for evaluating smoke and gas accumulation, dispersion and other phenomena, it is an obvious opportunity for improvement in

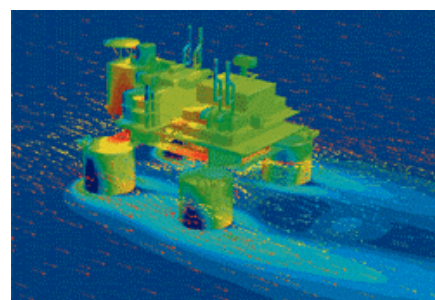


Figure 3. Flow vectors and pressure distribution. Courtesy of Norsk Hydro taken from Fluent Inc.

⁷ Hansen, E. Sintef Energy Research. Offshore, *Computer Simulation Helps Increase Flow Rate in Three-Phase Separator*. Sep2001, Vol. 61 Issue 9, 163.

Market Research: The Oil and Gas Industry

evaluating production equipment design and efficiency not readily apparent with other testing methods. For example, the study of wind loading on an oil rig platform utilises CFD to develop detailed models, which accurately predicts drag forces. The information gained with the CFD analysis is useful to modify the design to reduce drag and anchor chain loading.

3.3 Valves

The use of Computer aided engineering techniques to understand and improve valve design is gaining acceptance worldwide. Two of Fluent's clients, leading Italian valve manufacturers, Walvoil S.p.A and Petrovalves S.r.l., use CAE techniques to analyse complex valve geometries parametrically, to understand a range of gas and liquid physical properties, the compressible and incompressible flow regimes and to analyse the range of low and high pressure drops.

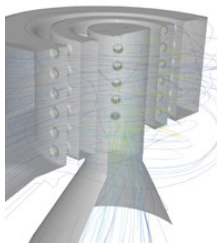


Figure 4. Flow pathlines in a pressure relief valve cage coloured by local magnitude. Taken from Fluent website.

These very few examples demonstrate that good engineering is critical to achieve maximum process efficiency, lower production costs and solving complex problems. The big operators have most certainly exploited these powerful techniques to enhance performance. The following section describes industry applications for big players like Mobil and BP Amoco and examples of contractors in mini case studies.

Market Research: The Oil and Gas Industry

4. Operators

4.1 Mobil Technology Company uses Flow Simulation

Mobil has achieved tens of millions of dollars in capacity and product quality gains by using CFD to improve performance of refinery process units such as reactors, separators, and extractors. Mobil has been using CFD software packages since the mid 1990s. A particular example of a simple CFD simulation with high payout for Mobil was the analysis of gas flow patterns in a spherical reactor vessel containing a fixed bed of solid catalyst. The height of the catalyst load determines the trade-off between allowable feed rate and reactor cycle length. Analysts evaluated gas flow patterns for various levels of catalyst fill, both in the vessel headspace and through the packed bed (Fluent, 2000). The determinations from the CFD findings allowed Mobil to increase the catalyst volume by 10%, which increased the annual revenue from this single reactor by \$2.2 million (Fluent articles 2000).

4.2 BP Amoco designs a new platform

In order to improve offshore platform safety standards, giants like BP have to exploit new technology to comply with standards of the legislative body for the oil and gas industry and also many safety issues and environmental conditions in the vicinity of the helideck, used for helicopter landing and take-off. Mobil used CFD simulations to analyse the effect of hot gases on helicopter operations at the proposed platform. CFD techniques was also used to model many different conditions. The simulation allowed the full path of the exhaust plume to be modelled and also the full flow field around the platform. This meant that other ventilation and dispersion effects was also assessed and understood.

Market Research: The Oil and Gas Industry

4.3 The Beryl Bravo Platform

Since the 1988 disaster on the Piper Alpha platform in North Sea, which claimed 165 lives, legislation in the UK has required the operators of offshore installations to produce a safety case for each installation. A safety case demonstrates that the methods of working and the operation of the installation reduces the risk of explosion and fire damage to a level that is as low as reasonably practicable (Weijde & Groenenboom, 1996).

The Beryl Bravo platform is located in the UK sector of the northern North Sea and includes drilling, processing, compression, utilities and accommodation facilities. The safety case for the Beryl Bravo platform had identified possible explosion scenarios in the process and compression areas of the platform. An advanced explicit finite element analysis technique was used to model an explosion on the Beryl Bravo. It was found that carbon fibres could effectively reinforce the blast walls, which can dramatically reduce the shutdown requirements.

In depth details is covered in the Blast Wall Bravura report (Civil Engineering, December 1996), but as a summary, the report suggested that the use of dynamic analysis with an explicit code takes into account the non-linear effects in the composite, strain rate and strain-hardening effects in the steelwork was used to demonstrate the effectiveness of the proposed strengthening method. A Netherland based Company, Engineering Systems International simulated the explosion conditions using the explicit FE code PAM-CRASH. The report also notes that this software has been used by many industries worldwide for detailed simulation of full-scale experiments in the automotive, railway and aerospace industries. The use of the dynamic analysis that takes the strain rate effects and plasticity into account shows that the wall is capable of resisting a higher load than that predicted by traditional implicit FE analysis (Weijde & Groenenboom, 1996).

Market Research: The Oil and Gas Industry

The report suggested that the project proved the cost efficiency of computer simulation, which if the conventional structural steel approach was used, then several weeks of shutdown would have to be carried out costing about \$1 million per day.

5. Contractors

Further down the stream, are the contractors to the industry. Master Flo Valve Inc. is an industry leader in choke, speciality control valve and pig ball valve technology for the offshore oil and gas industry located in Aberdeen, Scotland. The company utilise CAD/CAM systems and FEA systems to develop valve designs.

Another company, Zeta-pdm Ltd is the joint venture company formed by the founders of Zeta Dynamics Ltd of the UK and Process Design and Management BV (pdm BV) of The Netherlands. The Company is a specialist technology supplier and world leader to the oil, gas and petrochemical industries, focusing predominantly on various types of separation processes, which include: separators, gas scrubbers and degassers. In order to identify and rectify problems, the techniques adopted by the company include:

- Process Simulation- HYSYS⁸ calculations, Static and Dynamic
- CFD
- 3D Computer Modelling
- Testing and Third Party verification
- Research and Development

⁸ HYSYS is a process simulator with many calculations based on the conservation of number of moles

Market Research: The Oil and Gas Industry

6. Talking to the Industry

In order to gain further insight, a few companies were contacted within the contractor level to see if the findings are similar to the findings in the secondary data. The style of the interview was very much freestyle, starting off with a brief introduction and prompted with questions depending on the respondent's answers. However, the main aim of the interviews was to gain information around the issues regarding particular trends in the respondents sectors, any particular mechanical engineering techniques used, magazines read for the sector and where possible rate for the outsource services and problems faced in their sector.

6.1 Submetrix Ltd. Tom Hiller- Marketing Director

Submetrix Sonar trace their origins back to 1983 when Bath University carried out research into interferometric sonar, for use in seabed surveying. Sonar equipment is used by the Oil and Gas industry for pipeline laying. It is used to map the areas of the seafloor by using sounds. However, Mr. Hiller suggested that not much in terms of mechanical engineering techniques are required because they already have a package, which will interpret the information taken from the sonar survey. The findings from this interview suggested that although sonar and seismic surveys is an important tool in the Oil and Gas Industry, mechanical engineering techniques might not necessarily play a major part in assisting in this sector.

6.2 Burgess-Manning. Kami Nezhati- Senior Process Engineer (Separation Division)

Burgess Manning Europe Ltd. Is an international ISO 9001 accredited process design, engineering and manufacturing company (Offshore Technology Website, 2002). The company has been supplying products and services to the offshore oil and gas markets for a number of years. The company uses CFD for optimised process, vessel and internals

Market Research: The Oil and Gas Industry

design; for example, gas/liquid and solid separation equipments, gas conditioning and processing equipment and liquid processing equipment.

Kami Nezhati has been in the Oil and Gas industry for over 20 years. He designs separators for the Oil and Gas Industry and says that CFD is widely used in his sector for design separators to analyse the flow pattern of the product and then to fine tune the design. In the past, it was the big contractors like Shell and BP who carried out the research and development. Although recently, the onus is placed on contractors and is a growing trend in the industry. For example, if a contract is won by a contractor from the operator, then it is up to the contractor to carry out all the process design analysis and to make investment in the development of the equipment involved. The main approach for resource for contractors to turn to is quite often Universities who have research facilities and small companies who are experts in a particular technique.

These findings are supported by the data found in section 3.1 about claims in the use of CFD and computer simulation for multiphase separators used widely in the offshore oil production. It is understood that the use of CFD in particular is extremely useful in analysing the activities of oil, gas and water flows in separators.

6.3 SeaMark Systems Limited. Martin Hardy- Principal Engineer

SeaMark Systems Limited manufactures and supplies a range of subsea products including; mattresses for protection, stabilisation and anti-scour, anti fouling identification markers, anti fouling structural cladding and the design of fabric formwork systems and offshore grouting services based in Edinburgh (Offshore Technology Website, 2002).

Martin Hardy responded that FEA and mathematical modelling are frequently used in production and plant repair. FEA is often used in a repair situation and it is common practice in the sector to confirm the load on platforms and jackets using this technique.

Market Research: The Oil and Gas Industry

CFD is not so commonly used but is applied to test specific items such as separators because oil contains a lot of impurities and CFD for a computer simulation can help understand the activities. This response corresponds with the previous findings in section 3.1 and 6.2. Hardy also suggested that when anything is put on the seabed, there is not much stability of structure, it is exposed to a variety of conditions and therefore, CFD might be more useful than FEA analysis in this instance.

Hardy stated that not much specific expertise is contained in house, and engineering consultants are brought in to do the review of the whole project rather than just on analysing a specific area. Approximate charging rate is from £80-£100 an hour. It is expensive, but Hardy quoted that this is an area where cost cutting is not an option and if expertise specialising in a particular technique is required, then they are brought in to do the job. Hardy also stated that it seems most of the CFD expert consultants are from Canada. And when the company have had to outsource for CFD expertise, they have mainly gone to Canada to get analysis work done. Although Hardy did mention the UK CFD expertise, he specified a trend that, “ It seems CFD originated from Canada”.

To round off, Hardy stated that the main magazines read in the industry is Offshore Engineering.

6.4 Bel Valves. Chris Williamson- Technical Manager (Design Department)

Bel Valves is a major international manufacturer specialising in valves and services for the Oil and Petrochemical industries based in Newcastle upon Tyne, UK.

In terms of activities in the industry, Williamson stated there are more oil and gas production activity in Russia, Mexico, Africa, Brazil and recently opened up the North Sea in the Norwegian sector due to untapped resources. The UK remains steady. This demonstrates that the Oil and Gas industry is an active industry and although news reports (Section 1.3 paragraph 3) are suggesting that tax increases will reduce investments, jobs, oil and gas production, it is possible that developments will continue to grow in the sector.

Market Research: The Oil and Gas Industry

Williamson responded that FEA analysis is used extensively in his sector of work for new product development. Where it used to be classical hand calculations can now be solved quicker by using FEA. CFD is not used much but only sometimes in conjunction with FEA. These analyses are usually carried out in house as expertise are contained in house but the company have had to acquire outsource skills to assist in analysing, one example is Newcastle University because Universities have a pool of resource and expertise. The charging rate is usually £80 per hour but grants are available to the Universities.

When asked about problems faced in the valve sector, Williamson responded that metal sealing is a big problem in the sector. Plastic Oaring are used to make plastic seals which are 'OK' for cars but for the Oil and Gas industry, there is a high amount of pressure and therefore, a continuing problem with metal sealing is a big headache to the sector. Valves also require metal sealing and are another problem area. FEA has been used to try and find a solution to make metal seals but have been unsuccessful.

Material technology is also a big problem encountered in the industry. Corrosion resistant properties are highly demanding in the sector with high impact at low temperatures. Hard coating onto soft metal is another highly demanding technique and Williamson suggested that these problems are constantly being dealt with, but so far research continues and little development is made.

Another problem is the testing in hyperbaric pressure chambers. In the UK, there are limited resources and facilities and limitations in size and depth of water to carry out actual tests and therefore simulation chambers are used instead. Otherwise, the only other option is to access overseas facilities.

IT seems that the above problems are potential development areas. These problems are constantly being investigated to find appropriate solutions and if various mechanical engineering techniques can be applied to find a solution, it would be a big leap forward.

Market Research: The Oil and Gas Industry

6.5 Dublok UK Ltd. Bob Cless- Technical Director

The company first pioneered the concept of multiple valving from the company's original base in Aberdeen in the late 1980's (<http://www.dublok.com>). Although Dublok are also involved with the valve business, Cless responded that their products are customer driven rather than being an innovative tool for development. The main system they use is the CAD system but a formula is readily available in the program for calculation purposes. However, FEA is used if it is a brand new situation where the valve is a different shape or material, therefore a new analysis situation is required, in which case FEA is used but is not carried out in house, although these situations do not occur often.

The difference between this company and the previous company, Bel Valves is that this company is a long established company producing valves in all forgeable materials from carbon steel through to stainless duplex and exotic alloys. Which suggests that they already have standard valve examples and modifications are made on existing products to meet client needs. Where a company is creating innovative products, then various mechanical engineering techniques are applied to determine knowledge of deformation and stress.

6.6 Valve (Engineering) Services Limited. Philip Roe- Engineer

As the name suggests, the independent engineering contractor is involved with valve problem solving, generation of piping specifications, project valve supply and inspection services (Offshore Technology, 2002).

Although not much was mentioned about techniques used, Roe provided useful insights to problems faced in his sector. It was stated that if the 'riser emergency shut down valve' stops working, then the platform stops working which creates a big loss in finance. Although it is unclear to the interviewer what the 'riser emergency shut down

Market Research: The Oil and Gas Industry

valve' is, nevertheless it does suggest that the valve is big business in the oil and gas industry and innovative techniques are demanded to make the equipment function as efficiently as possible in high pressure environments. Another problem Roe stated is the corrosion of valves because they are constantly exposed to sand and very obnoxious chemicals, the same kinds of problems suggested by Chris Williamson in section 6.4.

Market Research: The Oil and Gas Industry

7. Conclusions

The phase one research of the oil and gas industry suggests that good engineering is critical to success in every aspect of oil exploration, production, and refining.

The techniques mentioned includes CFD, where flows of gas, oil and water are concerned, such as in the development and analysis of separators, and FEA for areas where knowledge of stresses, deformations, strains are important such as for equipment in platforms or jackets where the structure is withstanding high impact of force.

Although, the report is only an insight and demonstration where mechanical engineering techniques can be applied, and only a small section was researched, it does seem to show that it is not possible to say that a particular technique is applied right across the oil and gas industry. Rather, different sectors within the oil and gas industry will require the use of different techniques. Therefore, if the oil and gas industry was chosen as a development for marketing, then segmentation and positioning would be an important element of the strategic management to target the right service to the right sector within the oil and gas industry. Further analysis is required to understand how fire assessments are applied in the industry as a new research insight and to understand the extent of the UK company operations, such as providing equipment worldwide is a recommended next stage research.

Market Research: The Oil and Gas Industry

References

Contacts:

Tom Hiller, Submetrix Sonar. 01373 852000

Kami Nezhati, Burgess-Manning. 01920 461268

Martin Hardy, SeaMark Systems. 01628 788614

Chris Williamson, Bel Valves. 0191 2659091

Bob Cless, Dublok UK Ltd. 0161 9254001

Philip Roe, Valve (Engineering) Services Limited. 01530 839923

Articles:

Elisabeth Crabtree, D. Jane Bower & William Keogh. Technology Analysis & Strategic Management, Vol. 9, No. 2, 1999. *Conflict or Collaboration: The Changing Nature of Inter-firm Relationships in the UK Oil and Gas Industry*. Carfax Publishing. Available on University of Bath Electronic Journal Services- Business Source Premier.

H. Hakansson (Ed.), *Industrial Technological Developments: A Network Approach* (London, Croom Helm, 1989); H.G. Gemunden & P. Heyedebreck, 'The Influence of Business Strategy on Technological Network Activities', *Research Policy*, 24, 1995, pp. 831-850; D.J. Bower & E. Whittaker, 'Global R&D Networks; The case of the Pharmaceutical Industry', *Journal of Industry Studies*, 1, 1993, pp. 50-64.

Hansen,E. Sintef Energy Research. Offshore, *Computer Simulation Helps Increase Flow Rate in Three-Phase Separator*. Sep2001, Vol. 61 Issue 9, 163.

Market Research: The Oil and Gas Industry

H. Berger *et al.*, 'Understanding the Subcontracting Relationship', paper for the Tenth EGOS Colloquim, Vienna, July 1991.

I. R. Macneil, 'Relational Contract Theory as Sociology: A Reply to Professors Lindenberg and de Vos', *Journal of Institutional and Theoretical Economics*, 143, 1987, pp. 279-290

N. Luhmann, *Trust and Power* (Chichester, John Wiley, 1979)

Pieter J. van der Weijde & Paul H.L. Groenenboom. Civil Engineering. *Blast Wall Bravura*. Page 62-65. December 1996.

Bath Online databases: Business Source Premier. Offshore, Sep 2001, Vol. 61. Issue 9, p163. Computer Simulation helps increase flow rate in three separator.
[Accessed on 01/05/02]

Corporate Watch- The Oil and Gas Industry guide for UK activists. Winter 1997/98
[http://www.corporatewatch.org.uk/publications/oil_gas.html]

Computational fluid dynamics solves solids build up problem in process piping, Dick Jung. 1999 <http://www.fluent.com>

DTI, The Energy Report- Oil and Gas Resources of the UK, pub. The stationary office, 1996, p.15

Mobil adds million dollar benefits by using flow simulation to optimise refinery units. Greg Muldowney. 2002. <http://www.fluent.com>

<http://www.rigjobs.co.uk/oil/history.html>

[Accessed on 26/04/02]

Market Research: The Oil and Gas Industry

<http://www.ft.com>, Producers step up campaign against North Sea taxes, Mathew Jones. May 8 2002-05-13
[Accessed on 09/05/02]

<http://www.ukooa.co.uk>
[Accessed on 26/04/02]

<http://www.fluent.com>
[Accessed on 02/05/02]

<http://www.offshore-technology.com/contractors/project>
[Accessed on 29/04/02]

<http://www.sea.co.uk/submetrix>
[Accessed on 25/04/02]

Market Research: The Oil and Gas Industry

The Food Processing Industry

Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

Contents

1.	Introduction- what's happening in Britain's Food Processing Industry?	3
1.1	The new discovery in food processing	3
1.2	UK research	4
1.3	The food processing industry in general in terms of consumer tastes	5
2.	Case Studies	
2.1	Case study- The Carrier Technology Programme	6
2.2	Case Study- APV Baker Ltd, Mr. Dougal Crisp- Principal Engineer	9
2.3	Case Study- J.Redmond & Son Ltd, Mr. Jim Redmond- Director	12
2.4	Case Study- Handtmann, Mr. Steve Thurston- Service Manager	13
3.	Conclusions	13
4.	Recommendations	15
	References	16
	Appendix	18

Market Research: The Food Processing Industry

1. Introduction- what's happening in Britain's Food Processing Industry?

The food and beverage industry is probably the biggest and perhaps the oldest processing industry in the world. Over many years, the processing and preservation technologies used in the food industry has advanced considerably. These technologies include:

- Heating
- Drying
- Irradiation
- Concentration
- Freezing
- Chemical preservation
- Chilling
- Fermentation
- A combination of those technologies

1.1 The new discovery in food processing

Food and drink manufacturers have in recent years turned their attention to novel preservation processes in order to satisfy consumer's demand for additive free food and drink products with sensory attributes, which has a strong resemblance of it being fresh and non-preserved but a long shelf life so that it is easy to distribute and is convenient with current demanding lifestyles. (Richard Earnshaw; Campden and Chorleywood Food Research Association, 1996)¹. Hence, high-pressure preservation in food processing is increasingly being adopted but the very first research in high-pressure preservation was carried out almost a century ago. High-pressure equipment is very specialised and expensive. Pressure vessels are constructed out of forged steel or reinforced with tensioned wire windings. A lot of companies that make high-pressure equipment are actively involved in research into food and drink applications and there is a significant commercial interest in the UK, Europe, Japan and USA. Millions of pounds of research

¹ Appendix 1

Market Research: The Food Processing Industry

and development (R&D) investment have already been made in the development of high pressure food processing but we are yet to see the first European retail products.

1.2 UK research

Britain is very good in the pharmaceuticals, aerospace, and the oil and gas sectors, it's spending on R&D effort outside these areas is less than half the international average (David Whitehouse, BBC News Online Science Editor, 2001). The literature indicates that UK lags behind in research spending in chemicals, software, information technology, electronics and engineering. Only 10% of R&D is carried out in electronics, chemicals and engineering-less than the worldwide figure of 17% for these categories (BBC news, Sci/Tech. Sept 2001).

The good thing is, Britain does do far more research than is usual in other countries is in food processing and in the oil and gas industry. Unfortunately, the report does not clarify the '*kinds*' of R&D taking place in food processing and the words '*food processing*' can cover many areas. It is important to define the term, early on in this report because the kinds of research may be irrelevant to Eatec's interest, which is to find if there is a need for improved 'engineering software tools' to help solve processing problems and in the research and development phase in new machinery, and ultimately aid the solution of process problems and test various '*What If*' situations in food processing equipment.

The kinds of R&D which the report is talking about is likely to also include tests on raw materials, foods in process and finished products. The kinds of testing carried out in food processing laboratory's may include; Physicochemical, classical methods of bacteriology, colorimetry, laser granulometry, and probably many other terms which we are not familiar with in our field, but in which case, we cannot solely rely on the statement, ("...one area in which Britain does do far more research than is usual in other countries is in food processing..."), in order to assume that there is a growing market for Eatec to make it's marketing plans.

Market Research: The Food Processing Industry

1.3 The food processing industry in general in terms of consumer tastes

KPMG Corporate Finance has recently commissioned an independent survey involving CEOs from a broad cross-section of food processing companies across Europe to understand future prospects, the key challenges the industry is facing, and how they might respond to these challenges. Parallel to Earnshaw's report discussed in section 1.1, KPMG also found that changes in the food processing industry are driven primarily by lifestyle changes. Consumer tastes are increasingly moving towards healthier and more convenient products such as organic, functional foods and meal solutions while demand for more traditional products, such as meat and meal components/ingredients is showing lower growth or decline. What this means is that growth and profitability prospects for the food processing industry should be better than the last five years due to these demands.

Supporting this, a report from the Food engineering & Ingredients (October, 2000)² found that in the case of savoury snacks, markets are booming everywhere, as busy consumers demand foods they can grab and eat on the run. In the saturated markets of the USA and the UK, a slow-down and even decline in some areas was recorded, as consumers are tending to skip breakfast and eat snacks throughout the day (Maureen Byrne, 2000). For snack manufacturers, this is good news and many breakfast cereal companies have introduced cereal bars to try to win back some of their straying consumers. British consumers are also showing a strong preference for crisps. These changes in consumer demands ultimately have a knock on effect on manufacturers to come up with a wider range of added-value snack products, which means more innovative and creative food processing machinery and technology.

In the KPMG Corporate Finance report, 85% of respondents from the Netherlands, Italy and Spain believed that the prospects for future growth and profitability are as good and better than for the last five years. However, in the UK and Germany, 45% of the respondents are less optimistic about the future for the sector believing that prospects are much worse. Why is this, despite the changing demands in consumer taste?

It was found that pricing pressure arising from retail consolidation in both the UK and Germany is the primary reason for the less optimistic look. UK CEOs are also concerned

Market Research: The Food Processing Industry

about the impact of lower priced imports. In addition, the strength of sterling has led to a growing trend of retailers sourcing product in mainland Europe rather than buying in the UK (KPMG Corporate Finance, 2000).

However if the UK is spending more research on the food processing industry and yet the trend is suggesting that retailers are sourcing product from mainland Europe, this does not seem to encourage research and growth in the UK at all. To gain more realistic insights, I spoke to a few of the food processing equipment manufacturers to try find out how the food processing equipment manufacturer market works.

2. Case studies

2.1 Case study- The Carrier Technology Programme

The project involved the three leading UK research and technology organisations (RTOs) that serve the food industry:

- Campden & Chorleywood Food Research Association (CCFRA)
- Refrigeration and Process Engineering Research Centre (FRPERC)
- Leatherhead Food Research Association (LFRA)

The project was written in 1997 and the aim was to demonstrate the application of CFD (computational fluid dynamics) in relation to food processing in the following areas. This is to promote that CFD can be adopted by the food industry and such techniques need to be validated against physical models and their effectiveness demonstrated in the food industry:

- Flow of food materials in pipe system (CCFRA)
- Air movement in refrigeration systems (FRPERC)
- Performance assessment of ovens and dryers (LFRA)

The aim was also to communicate the benefits of CFD to the food industry and to inform companies about how to assess and access this technology by applying it to example

² <http://www.fei-online.com/ISSUES/CEREALS.pdf>

Market Research: The Food Processing Industry

problems in the pilot plant and on a full-scale production plant. The participating companies included:

Demonstration Project 1 (CCFRA)- Application of CFD to the flow of food materials:

- CFDS
- CPC (UK) Ltd
- HJ Heinz Co Ltd
- SmithKline Beecham
- United Biscuits Ltd
- Unilever Research

Demonstration Project 2 (FRPERC)- Application of CFD in refrigeration systems:

- Carter Refrigerated Displays Ltd
- Foster Refrigeration Ltd
- Hussmann Mfg Ltd
- Alan Nuttall Co Ltd
- Radford of Bristol Ltd
- Safeway Stores Plc
- J Sainsbury Plc

Demonstration Project 3 (LFRA)- Application of CFD to ovens and dryers:

- APV Baker Ltd
- Cadbury Ltd
- CHAM Ltd
- Kellogg Co of GB Ltd
- Trebor Bassett Ltd
- Weetabix Ltd
- Tetley GB Ltd

The individual demonstration activities undertaken by the RTOs had a varying level of research and risk associated with them. Each involved the assembly of a test rig, which could be modelled, and the models validated before going on to tackle real problems associated with production plant (The carrier technology programme, 1997). The purpose of this first phase was to develop confidence in the modelling framework and its ability to accurately simulate the phenomena being observed in the pilot plant. This

Market Research: The Food Processing Industry

allowed the researchers and industrialists the opportunity to learn about CFD and develop confidence in the results from this powerful simulation technique.

The report was concluded with the benefit that the transfer of CFD approaches to the food industry has started to yield benefits to companies both inside and outside of the project, providing new insight to the likely performance of fluid handling equipment at the design stage. Equipment such as ovens, controlled temperature stores, fillers and pumps has been improved through the application of CFD techniques in aiding the understanding of their operation and, more importantly, likely operational pitfalls (Project Summary- Status May 1997).

I spoke to Andrew Giegel at the Refrigeration and Process Engineering Research Centre at the University of Bristol, one of the project proposers. Giegel expressed that engineering techniques such as CFD are not widely applied in the food processing industry. It was felt that although participants in the programme were agreeing that CFD approaches to the food industry are beneficial in speeding processes, many are not actively making the change within their companies because of the large investment costs involved. Many large organisations are interested in trying to increase profit rather than looking at the long-term benefits of using such techniques and the competitive advantage that can be gained. And if it means digging into the company's pockets to invest and train up staff to use engineering techniques and installing software, and there is no guarantee of immediate visible sales profits, Companies are not interested and are not taking that risk. If this is the case, can we assume that companies would prefer to adopt external resource as and when the technique is required in a particular project? Giegel expressed that this is likely to be the case.

The 'big boys' in the market are not interested in 'change'. The attitude is, if it works, why change; stick to the knitting is what is best. Change means risk and thus, many are not interested in innovation. However, those who are probably more likely to adopt the ways of working in the food processing industry are the young, small hungry companies who are willing to try anything to take a slice of the market. It is sad but true, but the 'hungry people' are not based in UK anymore and decreasing in Europe too. Instead, with experience of working with China, Giegel indicated that the knowledge is slowly moving outside of our territory and predicts in ten years time, it is us who will be buying back the products from outside. Which goes back to the argument, because it is the

Market Research: The Food Processing Industry

developing countries that are willing to take a risk and make long-term investments. Giegel was working on application of CFD in refrigeration systems in China.

Following this report, a few thoughts came to mind. Firstly, this way of demonstration is a good way to actively promote use of technology by inviting industrialists into Eatec's office and provide the opportunity to learn something new and create commercial competitive advantage. Secondly, although it was demonstrated that CFD is a powerful simulation technique, can or how have the companies applied this to their existing work? Are there any limitations, which restricted them in applying this technique to their work apart from the issues related to risk in change management and long term investment discussed earlier? To answer this, I spoke to APV Baker Ltd, one of the participating companies and two more other food processing equipment suppliers, J. Redmond & Son Ltd and Handtmann, both UK based manufacturers to understand if CFD is really so widely applied to the food processing industry, more specifically, the food processing equipment companies.

2.2 Case Study- APV Baker Ltd, Mr. Dougal Crisp- Principle Engineer

Background

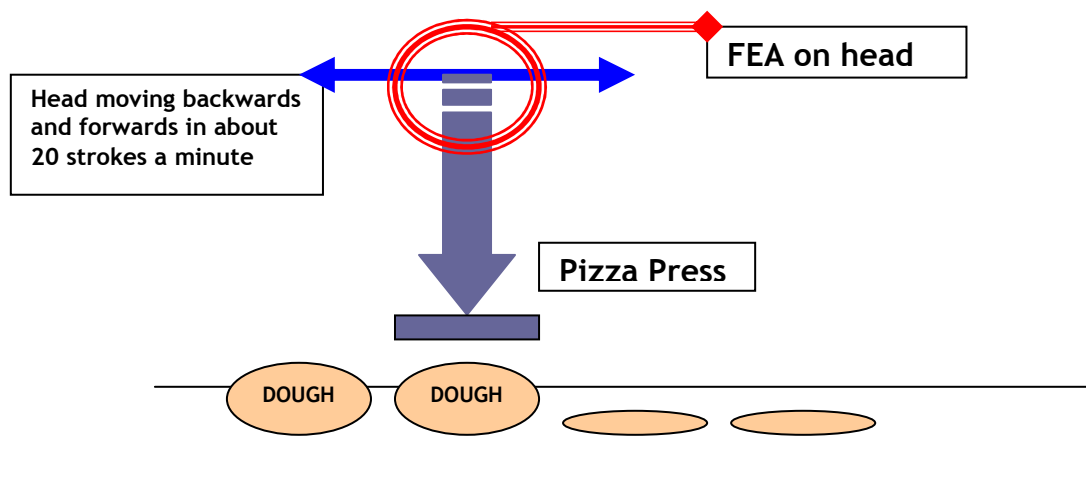
APV Baker (Part of Invensys) is a leading supplier of food process equipment in the UK and is one of the only companies offering fully integrated equipment and automation solutions to the food industry. They are involved with industrially produced baked goods such as bread and biscuits, snacks, confectionary and breakfast cereals. Prior to manufacturing, full production engineering is performed. Their equipment can provide a wide range of process options including cooking, flaking, toasting, coating, extrusion, shredding and drying. The technologies applied widely in their line of baked goods business are depositing process, hot press system (a forming method that injects exactly enough heat into the product before it is frozen), extrusion die (designed to meet consumer demands to make attractive products e.g., colourful stripy lollipops), and plate heat exchangers (consist of a series of profiled plates clamped together, with the material being processed and the heating medium, flowing through alternate plate gaps).

Market Research: The Food Processing Industry

Crisp expressed that APV Bakers was one of the first companies to adopt CAD &CAM in the food processing equipment industry. They are currently trying to promote 3D solid modelling and have a low volume of machine because depending on the end product, which the client wants to create, suitable equipment will be designed. It is not a case of making do with what technology is already available to create a limited and restricted product, but designing suitable equipment and technology to create the desirable end product.

Crisp did express that CFD was extremely useful in the new research of the thermal performance research oven. The initial problem was that the food product was baked in one area of the travelling band and the heat was not distributed evenly, which caused certain areas of the product to be burnt. This was a significant problem to the food industry. Hence, it would be of commercial advantage to research into this problem and try to create an extremely flexible batch oven, exactly simulating the baking conditions within the zones of a travelling oven. In this research, CFD was used to study 'what if' situations before a prototype was built which saved time and cost. Although validation needs to be done physically, it was proved that CFD was useful to the food processing industry.

They were also able to apply FEA techniques when APV Bakers was trying to analysing the stress and the strength of the pizza press unit. The problem was because the head was moving backwards and forwards in frequent strokes, the mass of the travelling head was important. With most equipment, because they are mostly quite bulky, it would be unnecessary to apply FEA to the equipment, but in this case it was useful to apply fatigue analysis to the pizza press head to create a stronger, longer lasting unit.



Market Research: The Food Processing Industry

Hence, APV Baker invested in a FEA tool on top of the CAD system, which allowed APV Baker to carry out many 'what if' studies to test the strength of various structures of heads. Crisp clearly expressed that without the FEA, the design could not have been achieved.

It is not often that the Company source external engineering consultants to help with problems, or make huge investments in applying these techniques as discussed in house, this depends on the project. Usually, the rule of thumb applies, for example, modifying current models, or relying on experience such as, "*This looks about right...*" or "*Let's just stick to what we know...*" attitude. Some jobs have issues with two conflicting results, for example, making it too light would not be right, but making it too heavy might cause the unit to be too stiff or not so flexible in movement. Since making hand calculations would take too long and there is insufficient resource in house to carry out that tedious task, in the first instance, FEA would be carried out by internal staff because the FEA software was purchased for one particular project and hence can be used again. However, because FEA experience is limited in house, in times of demands, engineering consultants will be sought to help solve the problem or find a solution.

For the last project where APV Baker had to bring in engineering consultants to carry out FEA analysis for stress and deflection on two platens, the consultancy rate was £15,000 fixed contract. This is an expected consultancy rate. If the analysis were carried out in house, it would cost APV Baker around £12,000 including training. Also the FEA package purchased only performs linear static and not dynamic analysis or modal analysis. Therefore, the quality of the analysis would not be as professional and thorough as one that was done by an engineering consultant.

And finally, some of the magazines they read include Eureka, Industrial technology and Professional Engineering.

The conversation with Crisp provided a valuable insight into how engineering techniques are used in an area of the food processing equipment manufacturer industry.

Although in a brief conversation with Mr. Graham Byas, a chemical engineer at Weetabix Ltd, the leading British breakfast cereal manufacturer expressed that it is difficult to apply advanced techniques in the food processing industry, and that it was somewhat behind

Market Research: The Food Processing Industry

than the pharmaceutical and medical companies. Weetabix rely on the manufacturers to tailor equipments specific to Weetabix requirements. If an engineering expertise is required, then the Company would contract out or go back to the original supplier. "Suppliers sometimes don't understand it much either". This suggests that engineering contracting services would be in more demand due to lack of expertise in the industry.

However, findings from J.Redmond & Son and Handtmann clarify why growth in this area might not be as optimistic as the case suggested for engineering consultants.

2.3 Case Study- J.Redmond & Son Ltd, Mr. Jim Redmond- Director

As a major player in the food equipment and machinery business, J.Redmond & Son Limited have a significant presence at the two largest equipment exhibitions for the food and meat industry. The interview was not long but provided valuable input to backup some of the less optimistic view about the growth of the food processing industry.

Redmond has been in the industry for many years, and said that in the food processing industry, 99.9% of machinery is imported from Europe. The Germans and Austrians are the leaders in food processing equipment manufacturers. Most UK food processing equipment companies are only acting as agents or distributor for an European based manufacturer. When I asked what distinguishes his Company's products to other UK food processing equipment companies, Redmond answered, "For each supplier in Europe, they would only have one agent in a Country. So I am the only agent for my supplier in UK and in the USA, representing their products." It is simple, like the mobile phone industry, food-processing equipment companies import standard equipment and badge their own company name on it.

There are very few food processing equipment manufacturers in the UK, with the exception of one or two like APV Bakers. This probably explains why Graham Byas said that suppliers have little understanding when they turn to them for specific design requirements because of the industry supplier set up as described by Jim Redmond of J.Redmond & Son Ltd.

Market Research: The Food Processing Industry

2.4 Case Study- Handtmann, Mr. Steve Thurston- Service Manager

Handtmann Limited is part of the German Handtmann group of companies, and one market leaders supplying filling & portioning equipment for the sausage and cooked meat industry and for other food and non-food applications.

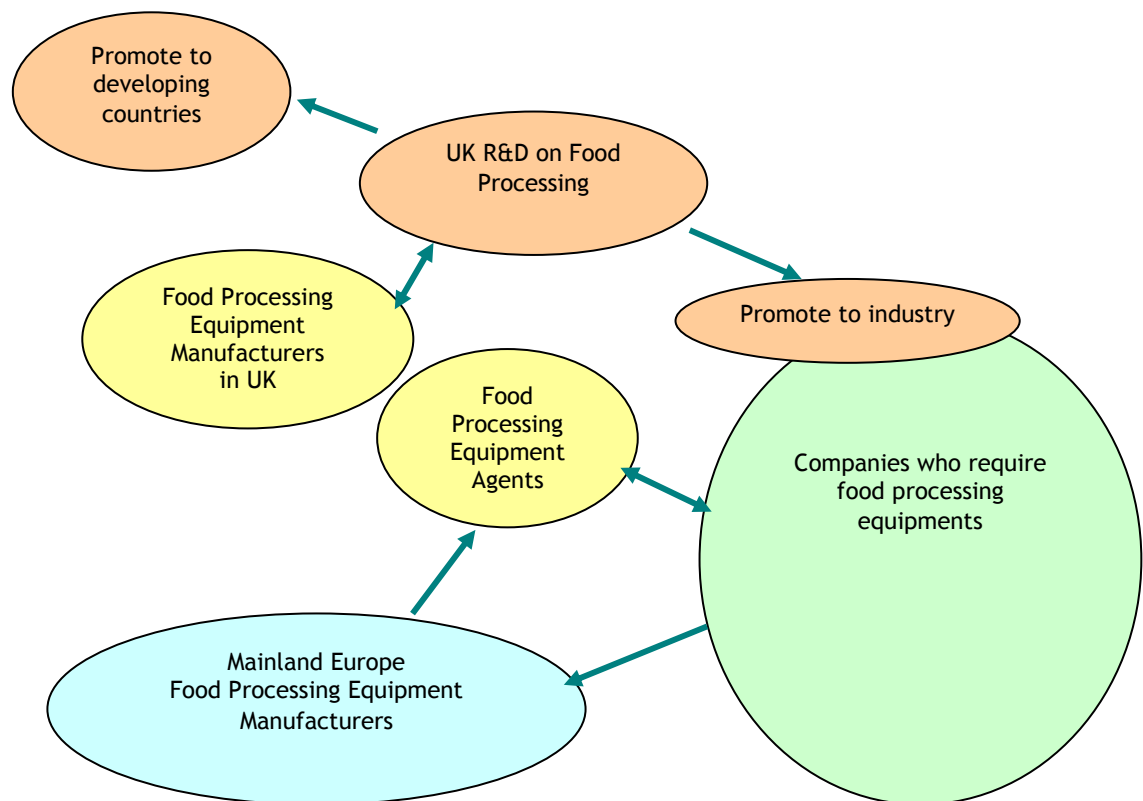
Thurston's response is similar to Redmond's response about the food processing equipment industry. Thurston estimated that about 90% of UK's food processing equipment is imported from Germany and 10% from Canada. When I asked about problems occurring with the equipment whilst in use here in UK, and what kinds of test or procedures are carried out to find a solution, Thurston responded that most systems have a fault finding facility and thus, very rarely need to utilise engineering techniques to solve problems.

3. Conclusions

It is recognised from the literature review that using CFD, food processing companies are encouraged to move to an ethos of 'right by design' before expensive 'build and test' plant trials. CFD simulations have proven to provide physical understanding of food processing problems in detail. In particular, improved modelling of flow, heat transfer and mixing properties will allow the time involved in developing food processes to be reduced and aid the solution of process problems. Therefore, CFD is a powerful design and analysis tool for the food and beverage industry to optimise processes and equipment.

However, the findings provide an insight into the market that growth in this area is limited because there are very few UK based food processing equipment manufacturers. If Eatec wants to develop in this area, it should look to target European Companies or try and target the one or two who do actually manufacture food processing equipments rather than acting as an agent, such as APV Baker.

Market Research: The Food Processing Industry



The UK Government report said that UK research is falling behind, in particular in chemicals, software, information technology, electronics and engineering. But research in food processing is higher than the rest of the world. Which should be a good thing for us. Having said this, KPMG's report expressed that UK food processing industry CEO's are not so sure about the optimism people are placing on the growth of this industry because for one, importing from outside is cheaper and thus more people are sourcing from Mainland Europe.

There is a lot more emphasis on research in food processing such as the Carrier technology programme where the regional technology transfer centres of the Ministry of Agriculture and Fisheries also assisted in dissemination through their own networks to promote use of CFD to tackle food processing problems and related issues. But this knowledge is not being fed back into the circle (see above diagram). Instead because it is cheaper to resource equipment from Europe, that's what most are doing. Even those food processing equipment manufacturers who claim to be manufacturers are only agents of products from Europe and just badge their logo on the machine when it is imported. Hence, R&D is increasing but knowledge is slipping away to developing countries and to those who do really want to create innovation.

Market Research: The Food Processing Industry

The views of Andrew Giegel are consistent with Jim Redmond and Steve Thurston. That is, already we are importing from Europe and soon from developing Countries like China. Innovation to improve is slipping.

If this area is to be taken forward, the smaller food processing companies are the ones to target. How many of these dominate the sector is not clear and would require a further exploration if this industry is to be taken forward for strategic development. Another view is, because bigger companies are reluctant to invest in engineering techniques in house due to the high risk involved with change and investment, there may be more opportunities for engineering consultants because companies are likely to buy in resource when it is required. The problem would be for us to decide how to segment the food processing industry and therefore who to target.

The RTOs disseminated information about the Carrier Technology project and how to use CFD to tackle food-processing problems to more than 7500 companies on their mailing lists. However, these companies are not only food processing related companies, but include any company to do with food. The market is so vast, that much more market segmentation must be done. The question is, is it worth our effort to spend time promoting the benefits into this industry in the UK when companies are either just importing from countries or are reluctant to change?

4. Recommendations

If this sector is to be chosen for the target markets for strategic development, further market research and exploring is required to understand if other types of engineering such as analytical and testing techniques are being used as well as the more familiar techniques like FEA or CFD.

Market Research: The Food Processing Industry

References:

Refrigeration and Process Engineering Research Centre- Andrew Giegel. One of the project proposers: 0117 928 9239

APV Baker, Dougal Crisp (past student from University of Bath, Mechanical Engineering), Principal engineer. 01733 283000

J.Redmond & Son. The academy of food machinery. Jim Redmond, Director. 07836 509772

Handtmann, Steve Thurston, Service Manager. 01582 576116

Weetabix Ltd. Graham Byas. gpb@burtonlatimer.weetabix.co.uk

Documents of particular interest:

<http://www.fei-online.com/ISSUES/CEREALS.pdf>

http://www.kpmg.de/library/surveys/satellit/food_survey_fas.pdf

<http://www.ictcarrier.co.uk/pages/cases/case2.html> (<http://www.ictcarrier.co.uk>)

<http://www.ppma.co.uk>

<http://www.apvbaker.co.uk>

<http://www.aiche.org/cep> March 2001

http://news.bbc.co.uk/1/hi/english/sci/tech/newsid_1560000/1560841.stm

<http://www.labsystems.com-> Case Study: The importance of the laboratory in Food Processing

Market Research: The Food Processing Industry

Nutrition & Food Science. Number 2. March/April 1996. pp. 8-11. High pressure food processing. Richard Earnshaw. MCB University Press. ISSN 0034-6659

University of Bristol Newsletter. Food Refrigeration and process engineering research centre- Rapid cooling of food. <http://www.frperc.bris.ac.uk>

FoodLink News- Newsletter for the food Link programmes- No 36 September 2001

Market Research: The Food Processing Industry

Appendix 1:

Demonstration of Computational Fluid Dynamics (CFD) to the Food Industry

Project Summary - Status May 1997

Project Proposers

Campden & Chorleywood Food Research Association (CCFRA), Food Refrigeration and Process Engineering Research Centre (FRPERC) and Leatherhead Food Research Association (LFRA)

The Need

There is a need for improved software tools for the modelling of food processes to improve process design and to help solve processing problems. In particular, improved modelling of flow, heat transfer and mixing properties will allow the time involved in developing food processes to be reduced and aid the solution of process problems. Such software techniques will allow much better use to be made of the information available from physical models of the processes. In order to be adopted by the food industry, such techniques need to be validated against physical models and their effectiveness demonstrated in the food industry.

CFD (computational fluid dynamics) modelling techniques have been applied in many industry sectors to aid design and optimisation of processes and individual pieces of processing equipment. This modelling framework allows the detailed simulation of the flow of fluids, heat transfer and concentration distribution within materials. The visual representation of flow properties, which is produced by CFD, can provide very useful new insights to the process.

Market Research: The Food Processing Industry

The Solution

The demonstration of CFD applied to real food processing problems and the validation of the software tools against physical measurements was considered essential for wider adoption and utilisation of CFD by the food industry. The project chose three key areas to demonstrate the application of CFD in relation to food processing. These were:

- flow of food materials in pipe systems (CCFRA)
- air movement in refrigeration systems (FRPERC)
- performance assessment of ovens and dryers (LFRA)

The Project

The three leading UK research and technology organisations (RTOs) serving the food industry collaborated in this project to demonstrate the application of CFD in the three areas mentioned above. Further, the project incorporated a broad based dissemination activity to communicate the benefits of CFD to the food industry and to inform companies about how to assess and access this technology. The project was not aimed at comparing and contrasting CFD codes, but at demonstrating how these could be applied to example problems in the pilot plant and on full-scale production plant.

The individual demonstration activities undertaken by the RTOs had a varying level of research and therefore risk associated with them. Each, involved the assembly of a test rig, which could be modelled, and the models validated before going on to tackle real problems associated with production plant. The purpose of this first phase was to develop confidence in the modelling framework and its ability to accurately simulate the phenomena being observed in the pilot plant. Examples based around food materials flowing in pipes, airflow in retail display cabinets, and

Market Research: The Food Processing Industry

airflows in ovens were chosen for this purpose. The first phase also allowed the researchers and industrialists the opportunity to learn about CFD and develop confidence in the results from this powerful simulation technique.

Within the industrial consortia associated with each of the demonstration projects, it has been possible to undertake simulation work closely aligned with the R&D needs of the companies to enable further assessment of the value that can be derived from the application of CFD techniques within the food industry. CFD codes are marketed by a number of companies and many are suitable for application in the food industry. Two codes have been extensively used in this project: CFX-4 (supplied by CFDS) and PHOENICS (supplied by CHAM).

Benefits

The transfer of CFD approaches to the food industry has started to yield benefits to companies both inside and outside of the project, providing new insight to the likely performance of fluid handling equipment at the design stage. Equipment such as ovens, controlled temperature stores, fillers and pumps has been improved through the application of CFD techniques in aiding the understanding of their operation and, more importantly, likely operational pitfalls. The benefits of CFD can be broadly categorised as:

- new insights and understanding of the process
- much greater range of "what if" investigations can be undertaken based on the physical testing
- shorter overall design times and times to solve problems
- improved overall process design by maximising the use of the physical data available

Market Research: The Food Processing Industry

Dissemination

Four dissemination seminars were held and the RTOs disseminated information about this project to more than 7500 companies on their mailing lists. In addition, the regional technology transfer centres of the Ministry of Agriculture and Fisheries have assisted in dissemination through their own networks. As a result of the project, each of the RTOs now has the capability to use CFD to tackle food-processing problems. Technical and overview material is available from each of the demonstration activities within the project.

For further information please contact:

Philip Richardson at CCFRA (01386 842036),

Andrew Giegel at FRPERC (0117 928 9239),

Mervyn Lewis at LFRA (0137 237 6761).

Participating Companies

Demonstration Project 1 (CCFRA) - Application of CFD to the flow of food materials.

CFDS, CPC (UK) Ltd, HJ Heinz Co Ltd, SmithKline Beecham, United Biscuits Ltd, Unilever Research.

Demonstration Project 2 (FRPERC) - Application of CFD in refrigeration systems.

Carter Refrigerated Displays Ltd, Foster Refrigeration Ltd, Hussmann Mfg Ltd, Alan Nuttall Co Ltd, Radford of Bristol Ltd, Safeway Stores Plc, J Sainsbury Plc.

Demonstration Project 3 (LFRA) - Application of CFD to ovens and dryers.

APV Baker Ltd, Cadbury Ltd, CHAM Ltd, Kellogg Co of GB Ltd, Trebor Bassett Ltd, Weetabix Ltd., Tetley GB Ltd

Market Research: The Food Processing Industry

The Paper Processing Market

Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

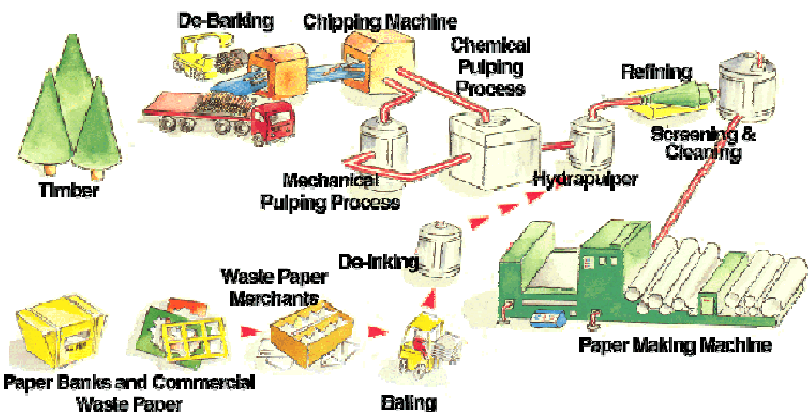
Contents

1.	Introduction- A flavour of the industry	3
2.	The Recent Trends	5
3.	Is there hope for growth?	6
	3.1 We ask the experts in the industry	6
4.	Conclusions	8
	Appendix	9

Market Research: The Paper Processing Market

1. Introduction- a flavour of the industry

There are 97 pulp, paper and board mills in the United Kingdom, employing approximately 19,000 people. These mills produce hundreds of different grades of paper and board, which are converted into a wide range of products for



use in industry, commerce, education, communications, distribution and in the home (such as tissues for household and personal use), together with a host of speciality papers for industrial use, e.g.: filters and papers which are subsequently coated, sensitised or laminated. In 2000 an estimated 12.9 million tonnes of paper and board was used in the UK.

Mills are concentrated in the north of Kent, Lancashire, the West Country and central Scotland. They have been located in these areas because in the past, paper mills depended on ample supplies of good water, which they still do but to a lesser extent, the developing industrialised towns which supplied the necessary rags and growing markets, and coal or the means of transporting it, often by canal.

Mills have not been restricted by these factors during the past few decades and planning a location of a paper mill is usually influenced by:

- Access to ports for imported raw materials
- Their proximity to markets and labour
- National transport facilities

The industry is highly capital intensive. A new paper or board mill can cost well over £200 million, and from the design stage takes some three years to come on-stream. To obtain an adequate return on investment the equipment has to be fully utilised and is therefore manned on a 24-hour continuous working basis. Modern machines can last for 25 years (The Economist 15/9/01).

Market Research: The Paper Processing Market

This makes the industry particularly sensitive to fluctuations in demand - adequate profit margins are vital to provide the investment necessary to remain competitive. Because the end product features in every aspect of social, economic and industrial activity the performance of the industry is loosely related to national growth. If economic growth slows, so does the demand for paper and board and profits fall.

Consumption of paper and board in the UK fell in 1990 for the first time since 1982. It fell again in 1991. It is therefore a constant battle for the industry to maintain production at a level, which permits it to retain its market share. The UK consumption of paper and board is met by home production and imports.

2000	Million Tonnes
UK Total Production	6.6
Exports	1.4
Thus UK Production for Home	5.2
Imports	7.7
Consumption	12.9

Source: The Paper Federation of Great Britain

The industry is divided into several sectors, mainly because the manufacturing and marketing of the various major grades of paper and board can differ greatly, e.g.: tissue has little in common with board. These sectors are:

- Newsprint
- Soft Tissues
- Printings and Writings
- Packaging Papers
- Corrugated Case Materials
- Boards

Market Research: The Paper Processing Market

Research and development is vital to the paper and board industry. The greater use of waste paper and the ever-increasing scope of specialist papers and boards, as well as energy conservation and anti-pollution measures, all require higher need in scientific and technological advances.

2. The Recent Trends

According to an article in *The Engineer* (26 Jan 2001) the UK paper industry is facing difficult times. Once a booming industry, providing over 70% of the country's paper and board requirements, the industry has not expanded at the same rate as its major European Competitors, and its international position has declined.

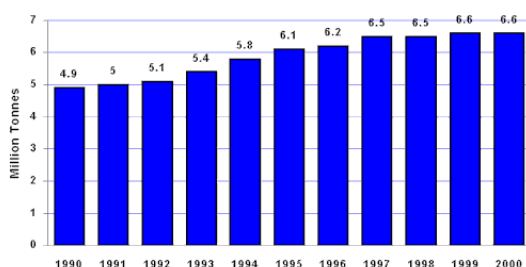
The world's third largest paper producer in 1960, the UK has dropped to twelfth and now imports 56% of its paper and board. The number of mills has also fallen, with 97 today, compared to 155 in 1975. In the last 12 months alone, eight mills have closed. The table on the right is taken from The Paper Federation to demonstrate some industry statistics.

The UK Paper and Board Industry 2000

COMPANIES	67
MILLS	97
EMPLOYEES	18800
TURNOVER (£M)	3500
CAPITAL EMPLOYED (£M)	3200
PRE-TAX PROFIT (£M)	100
CAPITAL EXPENDITURE (£M)	250
CONSUMPTION (MILLION TONNES)	12.9
PRODUCTION (MILLION TONNES)	6.6
IMPORTS (MILLION TONNES)	7.7
EXPORTS (MILLION TONNES)	1.4

Source: The Paper Federation of Great Britain

***UK Production of Paper and Board
1990 - 2000***



The competitiveness of the UK's paper industry has recently been harmed, along with other manufacturing sectors, by economic factors such as the high price of fuel. Donald Charlesworth, company secretary of Aylesford Newsprint (*The Engineer* Jan 2001) believes that a number of factors have restricted the industry's ability "the UK has had exceptionally high interest rates in past years, and an erratic exchange rate. When you get fluctuations like that, it destroys your ability to plan long-term".

Market Research: The Paper Processing Market

3. Is there hope for growth?

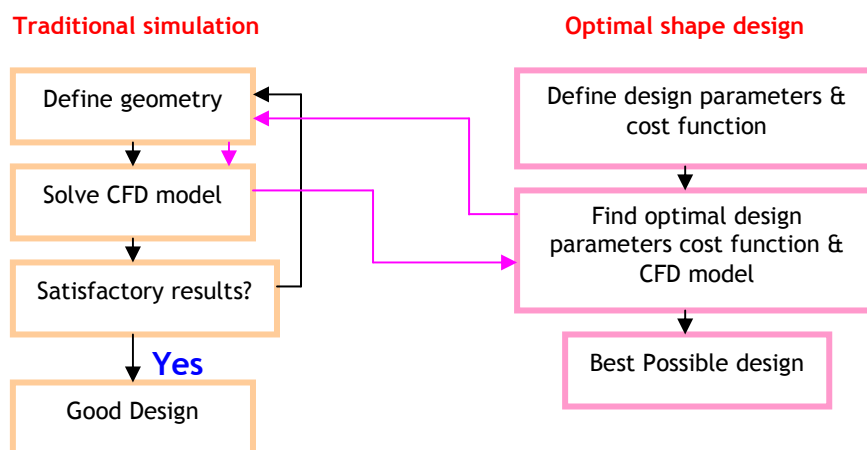
However, despite the pictures of mills closing, output has risen by 43% since 1989, while productivity has increased by 140%, according to the Paper Federation. Many of these efficiency gains have been brought about by technological improvements.

Equipment manufacturers have invested heavily in research and development, doubling the width of machines, while speed and output have tripled.

3.1 We ask the experts in the industry

Valmet Corporation, a Finnish-based manufacturer of papermaking machines is the world's largest manufacturer with a subsidiary in the UK known as Metso Paper. They organised a top secret R&D program to design the "Super Paper Machine". The goal was to significantly improve paper-manufacturing process while reducing its cost. The idea was to transfer and adapt technologies from other industries to the very special requirements found on papermaking machine.

Valmet has used shape optimisation together with Computational Fluid Dynamics (CFD) for some years in paper machine design because CFD accelerates stages of development and cuts down expensive and time-consuming measurements. Mathematical modelling and numerical simulation has also become one of the most important tools in R&D and has partially replaced measurements. Although experimental research is still needed in verification of simulated results (small scale experiments) and in validation of new products (pilot machine trials), it looks like other players in this market are beginning to latch on to this idea of technology transfer. Here's how it is incorporated in search of the best design for a paper machine:



Market Research: The Paper Processing Market

The respondents from the questionnaire also reflected a similar sort of insight. Some of the big paper machine manufacturers based in the UK which were given as references are:

- Sandusky Walmsley
- Metso Paper (Also known as Valmet)
- Voith (Voith Paper)
- Sulzer
- Peter Brotherhood Ltd

It was reflected from the respondent's answers that software is adopted to try to solve key design and engineering problems when designing or maintaining the paper machine, in alignment with Valmet's case earlier on. Most use CFD and FEA and some also mentioned '3 dimensional parametric', an engineering design package.

Usually, in the initial stages of research, design and development, and during maintenance, the manufacturers call in appropriate external experts to analysis the problem encountered, and they are aware of the costs involved but it is a situation where if one wants the problem solved, then the money needs to be spent.

Sandusky Walmsley at one point spent £13,000 for a CFD analysis for 100 hours of work. It seems that there is little engineering expertise kept in house because as mentioned earlier, modern machines can last for 25 years. Some manufacturers keep in house expertise such as Peter Brotherhood Ltd, but as a large equipment manufacturer in the UK with a turnover of £20m+ and a big client list they can afford to keep in house expertise.

Warburton Holder is also another equipment manufacturer (turnover £5m+) described as one of only a handful of companies in the UK paper machinery manufacturing industry with in-house manufacturing facilities.

In comparison to 20-30 years ago when more engineering experts were employed in house, most manufacturers today just outsource when the problem arises. The current engineering challenges are to improve paper quality and increase production speed to enhance productivity.

Market Research: The Paper Processing Market

In terms of the kind of engineering consultants sought, it was found that rather than employing consultants to just come in and solve a problem, these manufacturers preferred that an engineering consultancy sold a 'Solution'. This is far more favourable than one who fixes a problem and leaves.

Some of the journals read by the industry include, Tappi journal, Eureka, Engineering Design and Professional Engineers. There is also the Paper Industry Technology Association.

4. Conclusions

Interesting insight was gained from the report and aligning views from industry experts. Many are realising that the goal of increased economic efficiency in paper and pulp mills is to utilise specific modelling and simulation systems and their dependence on it will increase.

The advantage for Eatec is that it is in its early phase where, apart from the bigger manufacturers, many are depending on external engineering resource to solve their design and engineering problems. It is not an area where paper machine manufacturers and of course paper manufacturers (who often require external engineering experts to fix a particular problem or to find out why the machine failed) are tight on budget but a service which is required to keep on going.

As an initial conclusion, the report reflects a potential area for growth for Eatec to promote its engineering services.

Appendix

Market Research: The Paper Processing Market

Market Analysis Questionnaire - Paper Processing Machine

Question
<p>1.What are the key designs and engineering problems you face in designing the machine?</p> <ul style="list-style-type: none">- E.g. Understanding the loads the product may experience- Predict its behaviour under various loads or circumstances- Ensuring adequate fatigue life
<p>2.Have you used any advanced engineering techniques in the research, design and development stages?</p> <ul style="list-style-type: none">- Such as Mathematical modelling (prediction and simulating)- Computational fluid dynamics (fluid flow, heat and mass transfer)- FEA (assessing the stress of, say a particular area in a product. Can be used for all sorts of analysis like to measure the fatigue, cracks etc)- Testing with solutions
<p>3. Do you have engineering consultants in house or outsourced?</p> <ul style="list-style-type: none">- If the consultant is outsourced, does the consultant work in his/her own office or on contract based at your site?

Market Research: The Paper Processing Market

4. Which do you feel will be the new techniques and applications offered by consultants/contractors, which will be used increasingly in the future in your industry?

6. Which are the most important trade journals in your industry, which would be read by decision makers etc?

8. What do you think would be the typical price paid per day/per hour in your industry for the sort of consultancy/contractor services we have been talking about?

Market Research: The Paper Processing Market

References:

Contacts-

Sanducky Walmsley: Keith Parnell 01204 396060

Peter brotherhood: Chris Lockett 0161 797 3437

The department of trade and industry: Ivan Lima

Journal of Management Studies 34:2 March 1997: The thin line between advanced and conventional new technology: a case study on paper industry management.
Juha Lauila

Project Report. March 30. 2001. Vol. 21, No. 3.

<http://www.paper.org.uk>

<http://www.dti.gov.uk>

<http://www.isisusa.com>

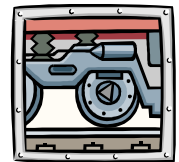
<http://www.pdc.kth.se>

<http://www.ppic.org.uk/htdocs/info/links/other.htm>

<http://www.pdc.kth.se>

The Rail Industry

Research Phase 1



Prepared by: Lindsay Cheng, TCS Associate
University of Bath, School of Management

Prepared for: Eatec Ltd

Contents

1.	Introduction- what's happening in Britain's Rail Industry?	3
2.	Identifying the Players in the market	4
3.	What do the people in the industry say?	7
4.	Conclusions	9
	References	10

Market Research: The Rail Industry

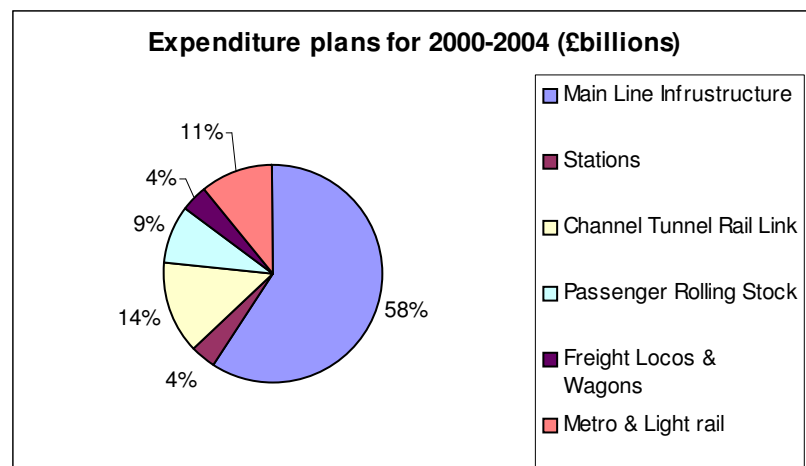
1. Introduction- what's happening in Britain's Rail Industry?

More people are moving into the Cities. Cities are congested with cars but too little space to park. Car parking fees can take up a hefty chunk out of your salary. In a nutshell, more people have to travel by train. The demand for rail travel is growing (The Railway Forum). Passenger journeys rose by 54 million (6.1%) and passenger kilometres by 2.2 billion (6%) in 1999/2000.

Decline in freight by rail has halted and showed a rise by 5.7% in 1999/2000. Since 1995, freight rail carryings have risen by 40%. The channel tunnel is providing new commercial opportunities for rail freight. The requirements of the rail freight industry come second to those of passenger operators in the UK. Despite this, the rail freight industry has achieved significant growth in recent years. This is the result of huge investment by EWS (the UK's leading freight company) and the government's desire to see more freight switched from road to rail. Government statistics show that freight growth continued unabated in the first quarter of the fiscal year 2000/01, with an 8.3% year-on-year increase in tonnes carried. Rail freight has now grown by over 41% since privatisation to the highest level in 20 years.

Research carried out for railtrack and The Association of Train Operating Companies

suggests that passenger demand will continue to rise over the next ten years - low forecast 23% and high forecast of 64% (passenger kilometres).



The government's recent 10 year transport plan, pledged £4 billion of capital and revenue support to the rail freight industry. The funding is to be overseen by the Strategic Rail Authority (SRA), which is expected to help the rail freight industry to increase the amount of goods it carries by 80% over the next 10 years.

Market Research: The Rail Industry

To develop Britain's railways, the plans for expenditure from 2002-2004 are shown on the diagram on page 3. This is to cope with the substantial growth in passenger and freight services. Rail investments are made to relieve the congestion on the roads, environmental enhancement and to assist in improved patterns of urban development.

UK companies have also proved successful in completing some of the largest rail projects undertaken in recent years (The Railway Forum, 2001), with capabilities to carry out the entire project or provide specialist support. For example, AMEC have been working on a viaduct and station construction project for Hong Kong West Rail and Balfour Beatty on the US Northeast Corridor (New Haven to Boston) awarded by Amtrak.

There is one arising problem and that is the lack of engineering talents entering the railway industry. The industry is already facing an acute shortage of engineers at a time when demand for their skills is at an unprecedented level due to the poor image of the industry (Lee Hibbert, Professional Engineering 2001). The good news for existing engineering firms is that investment in infrastructure and rolling stock is at the highest level for a lifetime, so there are really exciting prospects (Mike Etwell, former railway division chairman at the IMechE and consultant at Halcrow Engineering 2001).

2. Identifying the Players in the market

There are many suppliers of components to the Rail Industry but there are not many manufacturers of rolling stock¹ in the UK. Some of the suppliers to the industry are:

- David Brown Hygate - Gearboxes
- British Timken
- SAB Wabco Davies

The rolling stock companies own almost all the passenger rolling stock on Britain's railway and they lease it to the 25 operating companies. Rolling stock companies are in the process of investing over £2 billion in new and refurbished trains (The Railway

¹ Rolling Stock- the stock or store of engines and vehicles that run upon a railway

Market Research: The Rail Industry

Forum). At the time of privatisation, all the rolling stock used for scheduled passenger services was transferred to three rolling stock companies:

- Angel Trains (subsidiary of The Royal Bank of Scotland Group)
- HSBC Rail (subsidiary of HSBC)
- Porterbrook Leasing Company (subsidiary of Abbey National plc)

GL Railease and Halifax Asset Finance has just entered the market.

Rolling stock manufacturers are²:

- Adtranz (Now Bombardier)	Electric Multiple Units/Diesel Multiple Units
- Alstom	Electric Multiple Units/Diesel Multiple Unit
- Bombardier Transportation	Tilting Trains (diesel)
- Siemens	Electric Multiple Units
- Alstom/Fiat Ferroviaria	Tilting trains (electric)
- Thrall Europe	Freight wagons
- General Motors	Freight locomotives (diesel)
- Brush traction	Freight locomotives (electric)

Bombardier Transportation is the global leader in the rail equipment, manufacturing and service industry. Bombardier Transportation has a major presence in the UK, employing some 5,200 people across the country with manufacturing capability at the Derby and Wakefield sites. Bombardier's wide range of products includes passenger rail cars and complete rail transportation systems. It also manufactures locomotives, freight cars, propulsion & controls and provides signalling equipment and systems. Bombardier merged with Adtranz in 2001.

Alstom's Transport sector, with sales of 4.4 billion euros and a 17% worldwide market share, is a leading supplier of rolling stock, signalling, services and railway systems to the rail industry worldwide.

² <http://www.railwayforum.com> Fact sheet No. 7: Rail Rolling Stock

Market Research: The Rail Industry

Brush Traction is a wholly British-owned manufacturer offering a wide range of products within the rail traction rolling stock market, including diesel electric and electric locomotives.

Bombardier and Alstom websites indicate the extent of their involvement in rail industries around the world. An article in Railway Age (August 2001) reports that Bombardier Transportation, Alstom and allied companies have won approximately \$1.4 billion worth of orders for passenger railcars from European operators. Below are a couple of examples of the contracts awarded:

- RATP (Paris Transport Authority) awarded a consortium of Alstom, Bombardier and Technicatome a contract worth approximately \$585 million for 805 metro cars, which will replace about 40% of RATP's existing fleet beginning in 2005.
- Renfe (Spanish National Railways) awarded a consortium of Alstom and CAF a contract worth approximately \$370 million for supply and maintenance of 20 160mph, non-tilting Alaris trains. Alstom, whose share is 62% will provide the traction system and 50% of the mechanical equipment.

Examples of other consultancy firms operating in this industry are:

- Leyland Product Developments: a design, development consultancy to the Bus, Truck, Military and Rail industries, which offers a service from concept to manufacture using 3D CAD design services, Finite Element Analysis and prototype build facilities
- Interfleet Technology: An international company, which boasts a 'total rail systems consultancy'.

Market Research: The Rail Industry

3. What do the people in the industry say?

The main types of mechanical engineering consultancy employed in the industry would appear to be Finite Element Analysis and Reliability Analysis. One respondent from Bombardier Transport indicated that the rail market is definitely growing and has done so for the last three years, with the current rolling stock going out of date and needs replacing. The same response was reflected from a respondent from Brush Traction and from Bombardier Transportation metro business unit.

It was also felt that the railway industry was changing due to effects of urbanisation. Cities are growing with more people and require more trains, which reflects what was found in the literature. Higher expectations of customer service requirements are perceived by respondents to be the main changes taking place in the industry. As there are more trains, rail safety issues are a major concern and therefore, government pressures have a big impact on the industry. The main problem is due to the fatigue life of the rail vehicles. According to a report in Professional Engineering (Nov 2000) approximately half of the 12,000 rail vehicles in the UK are over 15 years old. This will change significantly over the next few years. By 2004, 61% of the fleet will be under 15 years old.

There is a shift from employing the services of external contractors to retaining more skills through the employed workforce. They acknowledge that this has been problematic as many engineers enjoy the flexibility of consultancy/contractor work. Bombardier tends to use agency contractors to work on site and only employ the services of consultancy firms for more specialised projects. The respondent from David Brown Hygate indicated that his company may also move in this direction. Consultants are perceived as being expensive and the lead times for completion of work is often too long. His company is shortly to make a decision about whether to continue to use consultants or whether to employ more in-house engineers to carry out analysis work. A respondent at Brush Traction also indicated they were moving in this direction and obtaining in house specialists and only outsource to external engineering consultancy's when overloaded. Respondent from the Metro business unit at Bombardier Transportation also expressed a similar response. It is usually expected to bring in consultants because it would not be practical to have so many in house specialists and have them '*sitting around doing nothing*' when the workload is less than usual and no

Market Research: The Rail Industry

resource is demanded. They have also indicated that they usually go and source experts from Universities in the engineering departments.

Other changes taking place in the industry according to respondents is the desire to use fewer suppliers, respondents from Bombardier and Alstom both reported that they have reduced their supplier list. Bombardier Transport have long term working relationships with suppliers and are charged anywhere, which can range up to the region of £1000 a day depending on the complexity of the project. To break into their supplier list is not easy. The manager at Metro Business Unit from Bombardier said that the consultancy must give them a benefit to change over to another supplier. It is not enough to say that one has been in the industry for a long time or have expertise because most engineering consultancy's do. What they are looking for is that the potential supplier can offer Bombardier commercial advantage if using their services instead. For example, there might be a brand new package out for FEA analysis or CFD and if the engineering consultancy is currently using this new package and Bombardier lacking expertise in this area, then it is an advantage to them to change to a new supplier who has experience in this new package. One way of keeping up with the trends is reading the industry trade journals or magazines such as Modern Railway or the Railway Gazette.

However, having said that, a Company as big as Bombardier have contacts straight from the Company who writes the software such as IBM. IBM would contact Bombardier direct with regards to new versions of new packages. For example, one package Bombardier is currently using is the CAD Catia, which can be directly linked with FEA to do the analysis straight from the design. Bombardier would usually work together with a supplier like IBM to come up with a new package. This demonstrates that businesses work together in partnerships rather than client supplier relationship. They work to solve a problem or develop something new together. These relationships can be hard to break into unless the potential new supplier has something different and innovative to offer which their existing companies do not have (Lee Glazier, Bombardier Transportation Metro Business Unit, 2002).

The primary research did not reveal any fundamentally new techniques, which are likely to be used in the industry in the future. However, the review of journal articles did indicate some techniques that are likely to be used more in the future.

Market Research: The Rail Industry

David Rollin, managing director of Interfleet Technology suggested in an interview for Professional Engineering (Nov 2000) that there will be growing use of condition monitoring to improve rolling stock reliability. Fault diagnosis and data logging techniques will monitor the condition of key systems and components, highlighting when repairs are needed and pre-empting failures.

Respondent at Brush traction indicated that techniques such as Mathematical Modelling and FEA are often used in house (the same with Bombardier Transportation) The techniques are used to perform crash simulation, dynamic and static analysis, CFD from thermal to acoustic. It is now routine to combine engineering techniques and simulation into much of the testing or predicting phases.

4. Conclusions

The UK is one of the leading countries in the world in the supply of services and consultancy to the railway industry. Research and innovation are the key strengths in this industry. Many companies work in highly specialised areas such as design, training and safety, providing support and expertise not found elsewhere.

Building on the experience of UK rail privatisation, it seems a number of UK groups are actively developing their business in overseas market. There is a growing demand of skills in such areas as rolling stock leasing, contracted infrastructure maintenance, and commercial service of operation. Hence, if an existing mechanical engineering consultancy can build on developing business relationships in the UK rail industry, when the continuing growth of railways take flight on a global basis, there is possibility of a greater demand for engineering consultants.

There is a huge potential for business development in this industry and will most certainly help Eatec to grow if business relations are successful. However, it will be a big challenge and more important is to differentiate our service to the other existing firms competing in the same area.

Market Research: The Rail Industry

References:

Bombardier Transportation- Helen Haddon HR Dept 01332 344666

Brush Traction- Bryan West Engineering dept 01509 617000

Bombardier Transportation Metro Business Unit- Lee Glazier 01332 266254

British Timken- David Burrows, operations and engineering manager:
burrows@timken.com

<http://www.interfleet.co.uk>

<http://www.riagb.org.com>

<http://www.railwaygazette.com>

<http://www.railwayforum.com>

<http://www.alstom.com>

Railway Age 'Freight Car Market Still Weak', Aug 2001, vol 202 Issue 8

Professional Engineering, 'Underdog of the Railways' 15 Nov 2000 p44

Railway Age, 'Europe, \$1.4 billion in passenger railcar orders' Aug 2001, vol 202 issue 8
p26

Professional Engineering, 'On the right track'. 31 December 2001 Col 14 Issue 2. pg. 46.
Lee Hibbert

Market Research: The Rail Industry

Market Analysis Questionnaire - Rail Industry

The aim of the questionnaire is to find out from design engineers/consultants in the Rail industry the engineering techniques used in the R&D phase of the product. This questionnaire is carried out by telephone interview.

Question
1. Is the Rail market growing, declining or static? Main changes?
2. What are the key designs and engineering problems you face in the manufacturing of rolling stock? I.e, in the design, research or development stage? <ul style="list-style-type: none">- E.g. Ensuring adequate fatigue life
2. Have you used any advanced engineering techniques in the research, design or development stages?
<ul style="list-style-type: none">- Such as Mathematical modelling (prediction and simulating)- Computational fluid dynamics (fluid flow, heat and mass transfer)- FEA (assessing the stress of, say a particular area in a product. Can be used for all sorts of analysis like to measure the fatigue, cracks etc)- Testing with solutions
3. Do you have engineering consultants in house or outsourced?
<ul style="list-style-type: none">- If the consultant is outsourced, does the consultant work in his/her own office or on contract based at your site?

Market Research: The Rail Industry

6. Which are the most important trade journals in your industry, which would be read by decision makers etc?

7. What do you think would be the typical price paid per day/per hour in your industry for the sort of consultancy/contractor services we have been talking about?

Many thanks for your response.

Appendix 3

Implementation following the segmentation process

This supplement covers stage 3 of the 'implement segmentation' phase (refer to figure 4.1 in main body of thesis showing the segmentation process). The process simulates the latter part of the segmentation process as illustrated by Goller et al's framework (2002): implementation of segmentation and control of segmentation.

The following section reviews what the directors agreed to do following the segmentation process at Eatec. The directors had felt that phase 1 and phase 2 (before and during segmentation) had taken too long. The directors wanted to see results and so far at this stage (one month into the second year of the researcher's marketing contract) nothing operational had been achieved except at a strategic level. The directors knew strategically which markets and clients to target but operationally they were unsure how or what they were going to do. The following section describes the plans and actions carried out following the findings gained from the segmentation process. The operational aspect of the strategic marketing plan to be discussed covered three areas and will be concluded with lessons learnt and a summary:

- Developing case studies to target clients
- Developing a mailshot campaign planner
- Finding out the effectiveness of the mailshot campaign

Integrate into strategy | case studies developed for target clients

Persuasive illustrations of successes are vital to winning work. The directors wanted to develop a range of case studies (sometimes known as success stories) to succinctly demonstrate where they had developed solutions that created benefits to their clients. The objectives of the case studies were to:

- Encourage a focus on the client's business rather than just technical features of a project
- Demonstrate to clients the benefits that other clients have received
- Articulate and quantify Eatec's contribution to success effectively

Customer testimonials and imagery in marketing materials (letters, brochures, case studies, success stories etc) are one of the most powerful marketing tools available. This is because prospective customers are more likely to believe praise about a company's service or product given by a referral rather than through some hard sale advertising (Geisheker, 2007; Parker, 2002). The AVS Group (www.avsgroup.com/casestudies/) published case studies on their corporate web site and found that this page consistently ranked in the top 10 in terms of visitors to the site, according to their 2006 site statistics (AVS Group, 2007). Such 'case studies' or 'success stories' helps to build credibility and provides the reader with new ideas and inspiration.

Hence, case studies were developed by the directors on an ongoing basis to highlight particular services and skills applied to problems in a specific industry. These case studies were provided with a coding for easy reference (CS001, CS002, CS003 etc.) because each set of case studies were sent with a covering letter attached with a tearaway slip for client feedback/comments. The case studies were sent out to prospective clients (selected in the macro and micro segmentation stages) in the form of a mailshot campaigns. The mailshot campaign was an important implementation stage as is discussed further below.

Integrate into strategy | develop mailshot campaign time planner

Having evaluated and selected target markets and prospective clients, these were fed back into the marketing strategy. This was an important step. The underlying logic of segmentation was that it enhanced marketing effectiveness and improved an organisation's ability to capitalise on marketing opportunities (Beane and Ennis, 1987; Weinstein, 1987). Organisations tend to over emphasise the mechanics of segmentation and fail to correctly implement the findings (Webster, 1991; Dibb and Simkin, 1997; Goller et al, 2002). Therefore it was important that the findings gained in stage 2 'during segmentation' were implemented in stage 3, the implementation phase. To capture the implementation plan, a mailshot planner was developed in the form of a matrix grid (figure 1).

Mailshot planner - updated Dec 2003								
* Groups	M1	M2	M3	M4	M5	Key:		
Group 1	Mar-03 CS001,CS002,CS003	Jul-03 CS004,CS005, ExTRACT	Oct-03 CS006,Audit Flyer	Jan-04 CS008,CS009	Apr-04 CS0010,CS0011		To Do	
Group 2	Apr-03 CS001,CS002,CS003	Sep-03 CS004,CS005, ExTRACT	Jan-04 CS006,Audit Flyer	Apr-04 CS008,CS009	Aug-04 CS0010,CS0011	CS00...	Sent	Case study still to write
Group 3	May-03 CS001,CS002,CS003	Sep-03 CS004,CS005, ExTRACT	Feb-04 CS006,Audit Flyer	May-04 CS008,CS009	Sep-04 CS0010,CS0011			
Group 4	Jun-03 CS001,CS002,CS003	Oct-03 CS004,CS005, ExTRACT	Mar-04 CS006,Audit Flyer	Jun-04 CS008,CS009	Oct-04 CS0010,CS0011			
Group 5	Sep-03 CS001,CS004,CS005	Jan-04 CS006, Audit Flyer, ExTRACT	Apr-04 CS008,CS009	Aug-04 CS0010,CS0011	Nov-04 CS0012,CS0013			
Group 6	Oct-03 CS001,CS004,CS005	Feb-04 CS006,Audit Flyer, ExTRACT	May-04 CS008,CS009	Sep-04 CS0010,CS0011	Jan-05 CS0012,CS0013			
Group 7	Jan-04 CS001,CS004,CS005	Apr-04 CS006,Audit Flyer, ExTRACT	Aug-04 CS008,CS009	Oct-04 CS0010,CS0011	Feb-05 CS0012,CS0013			
Group 8	Feb-04 CS001,CS004,CS005	May-04 CS006,Audit Flyer, ExTRACT	Sep-04 CS008,CS009	Jan-05 CS0010,CS0011	Apr-05 CS0012,CS0013			
Group 9	Apr-04 CS001,CS004,CS005	Aug-04 CS006,Audit Flyer, ExTRACT	Nov-04 CS008,CS009	Feb-05 CS0010,CS0011	May-05 CS0012,CS0013			
Group 10	May-04 CS001,CS004,CS005	Sep-04 CS006,Audit Flyer, ExTRACT	Jan-05 CS008,CS009	Mar-05 CS0010,CS0011	Jun-05 CS0012,CS0013			
Group 11	Jun-04 CS001,CS004,CS005	Oct-04 CS006,Audit Flyer, ExTRACT	Feb-05 CS008,CS009	Apr-05 CS0010,CS0011	Aug-05 CS0012,CS0013			
* All companies now extracted from Kompas into Excel = Totals to 11 groups.								

Figure 1. Mailshot planner developed for the implementation stage

The groups listed on the vertical column of figure 1 represent the groups that were filtered during the segmentation process as explained in section 4.3.3 and illustrated in table 4.11 in the main body of the thesis. The labelling on the horizontal row (M1, M2, M3.....) illustrates the mailshot campaigns. Each group would receive 4 mailshots per year (approximately 3 to 4 months between receiving each set of case studies and followed up with a phone call by the business development manager). Each mailshot campaign would include 2 to 3 case studies. For example, in Mailshot 1 (M1) case studies sent out to group 1 in March 2003 included CS001, CS002 and CS003. The next time group 1 received another mailshot was July 2003 which included another set of case studies (CS004, CS005, ExTRACT).

As the directors got used to writing case studies, it could be seen that later versions were used instead. For example, Group 5 received their first mailshot in September 2003, but their first set of case studies was not the original set: CS001, CS002 and CS003 that were sent out to groups 1-4, but rather CS001, CS004 and CS005.

The flexibility of having a matrix grid planner was that the directors could adopt a targeted marketing approach or selective specialisation (Kotler and Keller, 2005) where the directors could choose to target a number of groups with different services. There may be little or no synergy among the groups, but each sector group being equally attractive; Eatec could offer service information to those groups who they feel need it most and thereby maximising the use of services offered by the company. This selective specialisation approach was explained in the literature review chapter 2 in section 2.3.4 and was one considered appropriate to Eatec's situation. It also predominantly illustrates a needs/benefits segmentation approach (Bonoma and Shapiro, 1984). Depending on how the groups' needs varied, the director could adopt separate marketing strategies to provide appropriate case study information to each group sector.

Kotler and Keller (2005) noted that for marketing to be effective, the organisation should be staffed so that it would be able to carry out the marketing analysis, planning, implementation and control. Secondly, managers need to have adequate information and marketing tools for planning and allocating resource to different markets, products or territories. With this in mind, having a good management tool is good practice and the mailshot planner grid was devised specifically for Eatec's situation to help log and manage the increasingly complex outlook of the mailshot campaigns (which group received what and when) as illustrated in figure 1. The colour coding defined mailshots 'sent' and 'to do'. So following the two year marketing contract, Eatec could remain functional as an implementation plan had been defined with timescales for when to send out appropriate sets of case studies.

Control of segmentation | effectiveness of marketing strategy

Goller et al (2002) identified two specific issues as to why control strategies are instigated in the aftermath of the segmentation process. These are:

- 1) *Monitoring of segmentation in terms of segment stability.* The extent to which a segment remains homogeneous in terms of its defined characteristics could change over time (such as segment size, demographics characteristics, needs etc). Therefore segments need to be monitored to reconfirm the existence of originally identified segments. If change is detected, then re-segmenting the market may be necessary. This serves as a learning process which feeds back into the segmentation framework to assist with future choices of segmentation basis (Goller et al, 2002).
- 2) *Monitoring the marketing effectiveness in the various segments.* Bonoma and Shapiro (1984) have proposed using segment profitability analysis to assess the effectiveness of implemented marketing strategies. Such control measures help to establish whether intended strategies have achieved their aim and thus can be fed back into the implementation phase of the framework.

Over the last few years, the concept of marketing effectiveness has attracted increased attention among academic researchers and business practitioners (Norborn et al, 1990; Lai et al, 1992; Ghosh et al, 1993; Dunn et al 1994). In Eatec's situation, it was useful to try and gain an understanding of the level of marketing effectiveness at this stage since this is the underlying logic of segmentation (Beane and Ennis, 1987; Weinstein, 1987). If it is not effective, then issues can be fed back into the segmentation stages (Goller et al, 2002) and amendments can be made as and where required.

Studies into the control of segmentation are sparse (Goller et al, 2002) and so it is difficult to prove if effective marketing was the result of a successful segmentation programme. Mouzas (2006) highlighted various explanations on marketing effectiveness which is explained in the next section.

What is marketing effectiveness?

Mouzas (2006) adopts efficiency and effectiveness as central terms to assessing and measuring the performance of an organisation. Whilst effectiveness is associated with a company's ability to design a unique model of embracing business opportunities through exchange relationships, efficiency looks at the internal issues such as operational excellence or productivity. Therefore, measuring the effectiveness of Eatec's mailshot campaign would not be an indicator to how successful the segmentation process and framework had been, but rather the success of the segmentation process and framework that was designed for this purpose and how it helped the directors and business development managers create business opportunities through relationship building. Efficiency and effectiveness work hand in hand. Companies need to see efficiency as a necessary but not a sufficient condition and to consider effectiveness not just as an output but as a continuous process of impacting on their surrounding networks (Mouzas, 2006). Thus effectiveness in Eatec's situation is the continual process of developing networks and relationships through the target sectors and clients defined during the segmentation process.

Mouzas' (2006) theory implies that a segmentation programme could be devised specifically for a company's unique situation, but if the company has inefficient capabilities to carry on the process of developing relationships and networks, then no amount of segmentation effort would result in effective marketing that was expected from the bespoke programme. Likewise, a company could have all the resource it needs, but to go about marketing with a 'lets suck it and see' attitude would not be effective and thus strategic plans and frameworks need to be in place for managers to follow. As Mouzas (2006) stressed, it is not a case of one success (segmentation) ultimately results in the one success of another (marketing effectiveness); the company's internal operational excellence (efficiency) and the networking and relationship building attitude (effectiveness) need to work hand in hand for segmentation to have received ultimate success.

Another link established with marketing effectiveness is marketing culture. Webster (1995) defined marketing culture as the unwritten policies and guidelines which provide employees with behavioural norms. In the research, Webster (1995) identified two components (operational efficiency and customer philosophy) that were important to marketing effectiveness which ultimately affects the marketing culture:

Operational efficiency

If operational efficiency is considered important, then a culture must be developed to emphasise this through employee training, creative approach to developing new accounts

(selling task), the organisation and professional manner of employees and service quality. In section 4.1.1, we talked about the process of defining company objectives and employees were concerned with the lack of investment on staff training and personal development. The researcher recognised that the professional engineering consultancy service that Eatec provided was based on the reputation, unique skills and experience of each engineering employee (see figure 1.1 for Eatec's organisational structure in main body of thesis). Following discussions, the directors agreed to make significant investment in personal and professional development as one of the corporate objectives (as defined in objective 7 in table 4.1 of main body of thesis). Therefore, going by Webster's (1995) term, a 'marketing culture' has already been distinguished to instigate operational efficiency and in the long run this ultimately results in marketing effectiveness.

Customer philosophy

If strong customer philosophy (such as their values, needs etc) is considered an important component to achieving marketing effectiveness, then a culture must be developed around emphasises of the selling task and the company's receptivity to change and provide innovation to the client (Webster, 1995). This is a much more demanding component as it mirrors Bonoma and Shapiro's (1984) needs/benefits segmentation approach where the concept of the marketing culture is predominantly customer driven.

Following the completion of the segmentation process in late autumn 2002, the first set of mailshot was sent out in March 2003. To carry out the monitoring of segmentation in terms of segment stability, which was to look for changes over a lengthy period of time (Goller et al, 2002) was a little premature at this stage since it had only been 8 months since the segmentation process and 6 months since the first set of mailshot was sent out. Therefore, monitoring the market effectiveness in the various segments (or groups in this research) was more appropriate. Such control measures establishes whether the intended strategy (the mailshot campaign as a result of the segmentation process) had achieved its aim. The feedback could then be injected back into the implementation phase of the strategic marketing plan, where modifications could be made for the second round of marketing effectiveness analysis to maintain control of segmentation (Goller et al, 2002).

The aim and objective of controlling segmentation through monitoring the market effectiveness is summarised below:

The aim of monitoring market effectiveness:

The underlying logic of segmentation was that it enhanced marketing effectiveness and improved an organisation's ability to capitalise on marketing opportunities (Beane and Ennis, 1987; Weinstein, 1987).

The objective of the market effectiveness analysis:

Establish if the mailshot campaign, as a result of segmentation, had targeted the right companies and client. Ultimately the success of this assists the directors to maintain a continuous process of impacting on their surrounding networks (Mouzas, 2006).

In order to achieve the above, a questionnaire approach can be used to measure the existing level of marketing effectiveness and it can be specifically developed to suit the needs of a given organisation (Payne, 1988). This is discussed further in the next section.

Questionnaire design

The first step in the design of a questionnaire was to specify the information needed. It is also helpful to review the research questions and characteristics that influence the research design as well as having a clear idea of the target population and respondent group (Malhotra, 2005). A useful step by step guide was developed by Malhotra (2005) to assist in the design of a questionnaire (figure 2). The researcher designed the questionnaire following a similar process but not always in that order. This is explained below.

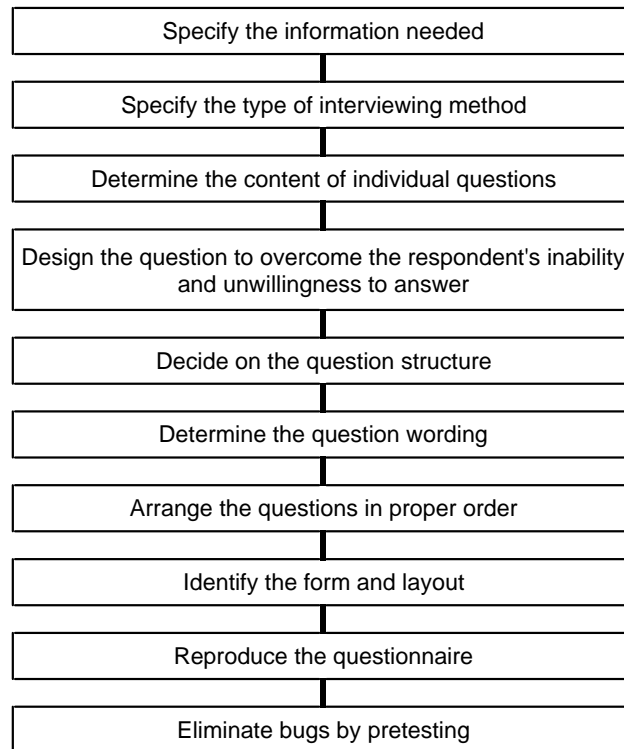


Figure 2. Steps to designing a questionnaire (Malhotra, 2005)

Specify the information needed

The marketing objective for Eatec was “to increase business by 15-20% over the next two to three years”. Following the segmentation process, a mailshot campaign was set up targeting the 11 groups that were defined during the micro-segmentation stage. The underlying logic of segmentation was that it enhanced marketing effectiveness and improved an organisation's ability to capitalise on marketing opportunities (Beane and Ennis, 1987; Weinstein, 1987). Therefore, the directors wanted to know how effective the mailshot had been six months into the campaign. The objective of the market effectiveness analysis was therefore to establish if the mailshot campaign, as a result of segmentation, had targeted the right companies and decision maker. Ultimately the success of this would assist the directors to maintain a continuous process of impacting on their surrounding networks (Mouzas, 2006).

Based on the above objectives, the researcher and the directors identified three areas that they would like to find out from the target groups:

- 1) find out if the decision maker found the mailshot relevant and useful
- 2) find out if Eatec had targeted the right companies
- 3) find out if the companies were likely to use Eatec's services

As well as reviewing the research questions and characteristics that influenced the research design, getting a clear idea of the target population and respondent group was also important information that needed to be clarified (Malhotra, 2005).

The respondent groups are the identified companies in the segmentation stage as discussed in section 4.3.3. The target companies were sub-segmented by regions, which resulted in 11 target mailshot groups. A mailshot planner was then devised as shown in figure 1. A random procedure method is equivalent to a lottery system where names are placed in a container, the container shaken and then the names of the winners drawn out in an unbiased manner (Malhotra, 2005).

The directors and the researcher agreed that the main criteria for selecting interviewing groups were that each must have received at least two sets of mailshots in order for the questionnaire to show indicative results. The assumption was that the first set of mailshot might be regarded as 'new information' to the recipient and so recollection of the context may be weak. When the second set of mailshot was received, it was hoped that this might bring about recollection upon the recipient regarding Eatec and its services. Therefore when the interview was carried out regarding the effectiveness of the mailshot campaign, the sample may provide a more informative response. With reference to figure 1 (mailshot planner developed for the implementation stage), the cells highlighted in grey indicated groups that have been sent mailshots. Those that received two sets of mailshot (M1 and M2) were groups 1, 2, 3 and 4 with group 1 having received the second mailshot in July 2003 and group 4 in October 2003. The market effectiveness analysis was carried out in October 2003. At that time, group 4 had just received a mailshot containing the second set of case studies from Eatec, whilst it had already been three months since group 1 had received their second set of case studies. It would be interesting to see if the recollection between group 1 and group 4 differed greatly.

Focal groups were used in this market effectiveness analysis. Malhotra (2005) noted for 'focal groups' that the typical range of four to twelve groups requires a minimum sample

size of two groups. In this research there were a total of eleven groups and the study concentrated on the response of four mailshot groups. The number of companies within each group is listed below:

- Group 1: 145 companies
- Group 2: 172 companies
- Group 3: 162 companies
- Group 4: 197 companies

It is common for marketing research projects to adjust the sample size required, although this is usually for the incidence of eligible respondents (Malhotra, 2005). Due to resource constraints such as time and money, it was not possible to interview all companies in the four groups so the sample size had to be adjusted for this incidence. The directors and the researcher agreed on the random sampling technique that approximately ten companies be drawn out in an unbiased manner. Individuals were chosen entirely by chance which reduces the likelihood of being biased about a certain population (Easton and McColl, 1997). This sampling technique also known as non-probability sampling has its drawbacks because such a sample provides no basis for evaluating the size of the sampling variation and the error of estimation (Ghauri et al, 1995).

However, at this early stage of segmentation and implementation of Eatec's strategic marketing plan, the objective of the market effectiveness analysis only aimed to provide insight into whether the mailshot campaign, as a result of the segmentation process, had targeted the right companies and decision maker. As a result, the researcher agreed with the directors that approximately drawing ten companies from each group would be manageable within the short time frame left to carry out the analysis and evaluation (the two year marketing contract between the researcher and Eatec was due to end in December 2003. The market effectiveness analysis was carried out in October 2003).

The resulting sample size is detailed below:

- Group 1: 11 companies out of 145 was selected (8% of group 1 population)
- Group 2: 12 companies out of 172 was selected (7% of group 2 population)
- Group 3: 13 companies out of 162 was selected (8% of group 3 population)
- Group 4: 15 companies out of 197 was selected (8% of group 4 population)

Specify the type of interviewing method

Mail questionnaires and telephone interviews are particularly important if a sample is needed from a large geographic area. Mail surveys tend to have relatively low cooperation rates and the extent of cooperation will be lower still if the survey instrument requires additional explanations (Wittink and Cattin, 1989). Yu and Cooper (1983) investigated research design effects on response rates to questionnaires. Their conclusions were based on 497 response rates found in 93 journal articles. As a method of contact, they found that there was a heavy reliance on the mail survey due to the low running cost involved. However, their findings agreed with Wittink and Cattin's (1989) conclusion that mail surveys are about half as effective as telephone surveys or personal interviews in generating responses.

In Eatec's situation, mail questionnaires and telephone interviews were the two possible options because groups 1 to 4 spanned a fairly large geographic area (Wittink and Cattin, 1989), with group 1 covering the south west region to group 4 spanning up to west midlands. Therefore, personal interviews were deemed too costly due to limited manpower to carry out the interviews. It would also have been very time consuming in terms of travelling to companies all over the region. Mail questionnaires would achieve a mass mail achievement but considering the likelihood of low response rates (Wittink and Cooper, 1989; Yu and Cooper, 1983) and time constraints, it was agreed with the directors that telephone interviewing was the most efficient way of obtaining response from all four groups.

Determine the content of individual questions

Specifying the information needed as described above was an important stage as this helped the researcher develop the content of individual questions based on what the directors had hoped to achieve from the market effectiveness analysis. Malhotra's (2005) guide to designing a questionnaire (figure 2) was not strictly followed at this stage as the researcher found it much less restrictive to determine the content of each questions in parallel to defining the question wording to see if asking a particular question was viable. Table 1 lists the agreed content of questions and the actual questionnaire wording.

Design the question to overcome the respondent's inability and unwillingness to answer

Malhotra (2005) highlighted that not all respondents are able to answer the questions posed to them because quite simply, they may not remember. This factor was considered in one of the questions during the process of when the content of the questions were determined (see table 1):

Do you recall receiving mailshots of case studies from Eatec?

The answer to this question should be 'yes' because the respondent groups selected were those that had been sent two mailshots containing two different sets of case studies. Answering 'no' meant that the mailshot was not very effective because the respondent did not remember it! It also meant that the questionnaire could not be continued as the questions that followed were based on the mailshot campaign. To overcome this limitation, the researcher designed a set of questions that could be asked based on the fact that they did not remember receiving the mailshot. It was interesting to find out if they might have had previous knowledge about Eatec and its services from another source such as a referral or from an advert in a publication.

Even if respondents were able to answer a particular question, they may be unwilling to do so. Refusal to answer a question may be due to a variety of circumstances. The respondent may feel that there's simply too much effort or that the question serves no legitimate purpose (Malhotra, 2005).

Content of question	Actual question wording
Is the mailshot targeting the right company	Does your company ever outsource work in prediction/analysis/simulation/testing/research to an engineering consultancy? Would it, if the need arose?
Is the mailshot was targeting the person	Who are the main decision takers for agreeing to work being outsourced?
Was the information sent effective	Do you recall receiving mailshots of case studies from Eatec?
Did the respondent have any previous knowledge about Eatec (prior to the mailshots)	Had you heard of an engineering consultancy company called Eatec before this call?
Did the respondent have any previous knowledge about the services that Eatec offers (prior to the mailshots)	Are you familiar with the services Eatec offers?
Find out about other successful methods of getting the Eatec name in the market if it wasn't through the mailshot campaign	Where did you hear or read about Eatec?
Find out if the information was read or not	Did you have the time to read the letter & case studies
If the respondent had heard of Eatec before (prior to the mailshots), were the case studies useful in providing added knowledge about what the respondent already knew about Eatec	Did the information broaden your knowledge of what Eatec does?
Measure the before and after effects of receiving mailshots	Before you received the information, had you heard of Eatec?
If the respondent had not heard of Eatec before (prior to the mailshots), were the case studies useful in providing knowledge about Eatec's services	Was the information useful in helping you understand Eatec's services?
Are Eatec's services applicable to the types of projects and problems that the respondent faces in his/her current job responsibility	Are Eatec's services relevant to the types of problems you are likely to encounter in your engineering projects and problems?
Based on the case studies the respondent received in the mailshots, what were their perceptions on Eatec's level of skills	Thinking of Eatec's skills in solving complex engineering problems, would you say their skills are: [High] [Above Average] [Below Average] [Rather Low]
Did the mailshots change the respondents' pre-conception, if any?	Do you now view Eatec in a different way than before you read the information? What is different?

Table 1. Questionnaire design - content of questions and actual wording

To overcome this barrier and to be prepared for potential awkward moments, the researcher developed some possible questions that the respondent might pose upon the researcher and potential answers (see table 2). As discussed in chapter 3 of the main thesis, the researcher adopted the role of academic researcher in this market effectiveness analysis. The respondents were advised that their contributions helped towards an academic research. This helped with the social elements of the interviewing because respondents were more likely to warm to the prospect of assisting with academia contributions than to assist a private sector company whose aim was to gather research for its own business development plans. There are of course ethical issues with respect to data collection in relations to trust and it is the researcher's obligations to resolve this (Bartels, 1967; Hunt et al, 1984). Therefore, the questions and answers highlighted in table 2 were developed with an aim to resolving this

ethical conflict by briefing the respondents about the nature of this research. This was predominantly to understand more about business-to-business segmentation in a small professional services company, with the aim to achieve an MPhil research degree.

Potential questions from respondent	Prepared answers
What's this questionnaire for?	To try and understand more about business-to-business segmentation in a small professional services company called Eatec. This research contributes to achieving an MPhil research degree at the University of Bath.
Do you work in Eatec?	Employed by the University of Bath on a 2 year Knowledge Transfer Partnership programme. The research is based on the development of Eatec's strategic marketing plan and segmentation process.
Are you a postgraduate student or an academic employee?	I am an academic researcher at the University of Bath. I am also enrolled as a part-time postgraduate researcher student to study for an MPhil in Management.
Will my response be fed back to Eatec?	Yes, but the main interest is the aggregate results. Individual responses remain anonymous.

Table 2. Questionnaire design – possible questions posed to researcher by the respondent

Decide on the question structure

In a single case study environment, semi-structured interviews are favoured because broad questions can be asked which do not constrain the conversation (this was highlighted in chapter 3 in the thesis). Certain response can be further probed by the researcher and new questions are allowed to arise as a result of the discussion. This also elicit the respondents ways of thinking about the issues with which the researcher was concerned, so minimising the degree to which the participant felt constrained was preferred (Bryman and Bell, 2004).

However, further review of the literature regarding participatory learning and action has highlighted that semi-structured interviews (Pretty et al, 1995) are usually best conducted in pairs with one person doing the interview and one taking detailed notes. Semi-structured interviews usually contain open-ended questions which are difficult and time-consuming to synthesise well enough to obtain clear results. The literature also suggested that it could be difficult to keep interviews focused, making different interviews difficult to compare properly. The objective of the mailshot effectiveness analysis was to establish if the mailshot campaign, as a result of segmentation had targeted the right companies and client within the six months since the campaign started in March 2003. Therefore to be able to make comparisons with simple statistics such as percentage would be useful.

Due to lack of time and money, it was not feasible to have the researcher trained properly to conduct effective semi-structured interviews. Therefore, the researcher felt that a relatively structured questionnaire with closed ended questions (yes or no) and scaled questions (high, above average, below average, low, no comment) would be more appropriate so that the researcher was not deviated away from the focal point of the question.

Arrange the questions in order

When arranging questions in a proper order, the researcher should consider the opening questions, the type of information sought after, difficult questions, and the effect on subsequent questions. Questions should be arranged in a logical order (Malhotra, 2005). In this questionnaire design, there were a number of 'yes' 'no' questions that resulted in the questionnaire verging off in two directions, or otherwise known as branching questions (Malhotra, 2005). It was initially difficult to arrange the questions on paper in a logical order; based on the answers given this had an effect on the order of subsequent questions.

For example (refer to figure 3), although question (D) was a yes/no answer, which lead to the same question (E), the subsequent questions and route of the questionnaire diverged (as illustrated by the colour coded lines). There could potentially be four different scenarios stemming from one question. The respondent could have:

- 1) Read the case studies (question D) and had heard of Eatec before (question E), which would then have lead on to question F, G, H and I.

Or.....

- 2) Read the case studies (question D) but had not heard of Eatec before (question E). This would then lead to question E1 because if the respondent had time to read the case studies, it was interesting to find out if the information was useful in helping the respondent understand Eatec's offering (question E1) and subsequently question G, H and I.

Or.....

- 3) Not had time to read the case studies (question D) but had heard of Eatec before (question E). So it made sense to ask to what extent was the respondent familiar with Eatec even if they had not read the case studies (question C3). Subsequently, if the response to question C3 was 'no' then the questionnaire has come to an end, but if it was 'yes', then the subsequent questions that followed were question G and H.

Or.....

- 4) Not had time to read the case studies (question D) and had not heard of Eatec before (question E). In which case the questionnaire has come to an end.

Already the researcher has demonstrated here using question (D) as an example that depending on how that particular question was answered, it could subsequently result in four possible routes to the questionnaire as illustrated by the colour coded lines. The researcher found that the diversion of questions happened quite frequently throughout the questionnaire design (as illustrated in figure 3) and so setting out a structured or even a semi-structured questionnaire where questions followed logically one after the other was difficult to represent on a standard questionnaire form.

Another complication factor was that questions (E), (G) and (H) were ‘overlapping’ questions, meaning the interviewer could have reached that particular question through various routes (again illustrated by the colour coded lines on figure 3). An example can be illustrated with question H. That same question would be asked but variables to reach that question would differ slightly:

1) *Pink coded line:*

- a. respondent had read the case studies
- b. heard or not heard of Eatec before
- c. found case studies useful
- d. services are relevant to respondent’s business

Based on these variables, how the respondent rated Eatec’s skills is asked through (H).

2) *Blue coded line:*

- a. respondent had not read the case studies
- b. heard of Eatec before
- c. found case studies useful
- d. services are relevant to respondent’s business

Based on these variables, how the respondent rated Eatec’s skills is asked through (H).

3) *Orange coded line:*

- a. respondent do not remember receiving the case studies
- b. heard of Eatec before
- c. are familiar with Eatec's services
- d. services are relevant to respondent's business

Based on these variables, how the respondent rated Eatec's skills is asked through (H).

As a result, the researcher had to map out the various routes depending on the question, its answer and then the subsequent questions that followed, hence figure 3 was created. The researcher found the design process much more manageable when individual questions were written down on a piece of card and moved around on a work surface until the right logical order and flow of questions (depending on 'yes' 'no' responses) was achieved. Once the researcher had tested various question and answer routes through the use of the flowchart and different routes colour coded, the questions were then written out on a form. The final layout of the questionnaire is enclosed overleaf.

Mailshot effectiveness questionnaire

Aim of monitoring market effectiveness:

The underlying logic of segmentation was that it enhanced marketing effectiveness and improved an organisation's ability to capitalise on marketing opportunities (Beane and Ennis, 1987; Weinstein, 1987).

Objective of market effectiveness analysis:

Establish if the mailshot campaign, as a result of segmentation, had targeted the right companies and client. Ultimately the success of this assists the directors to maintain a continuous process of impacting on their surrounding networks (Mouzas, 2005).

Sample:	Group (please tick)	1	2	3	4
----------------	----------------------------	----------	----------	----------	----------

a) Does your company ever outsource work in prediction/analysis/simulation/testing/research to an engineering consultancy?

a1) Would it, if the need arose?

b) Who agrees to the work being outsourced?

c) Do you recall receiving mailshots of case studies from Eatec?

c1) Had you heard of an engineering consultancy company called Eatec before this call?

c2) Where did you hear or read about Eatec?

c3) Are you familiar with the services Eatec offers?

d) Did you have the time to read the letter & case studies?

e) Before you received the information, had you heard of Eatec?

e1) Was the information useful in helping you understand Eatec's services?

f) Did the information broaden your knowledge of what Eatec does?

g) Are Eatec's services relevant to the types of problems you are likely to encounter in your engineering projects and problems?

h) Thinking of Eatec's skills in solving complex engineering problems, would you say their skills are:

<i>High</i>	<i>Above Average</i>	<i>Below Average</i>	<i>Rather Low</i>	<i>No comment</i>
-------------	----------------------	----------------------	-------------------	-------------------

i) Do you now view Eatec in a different way than before you read the information? What is different?

End of the questionnaire

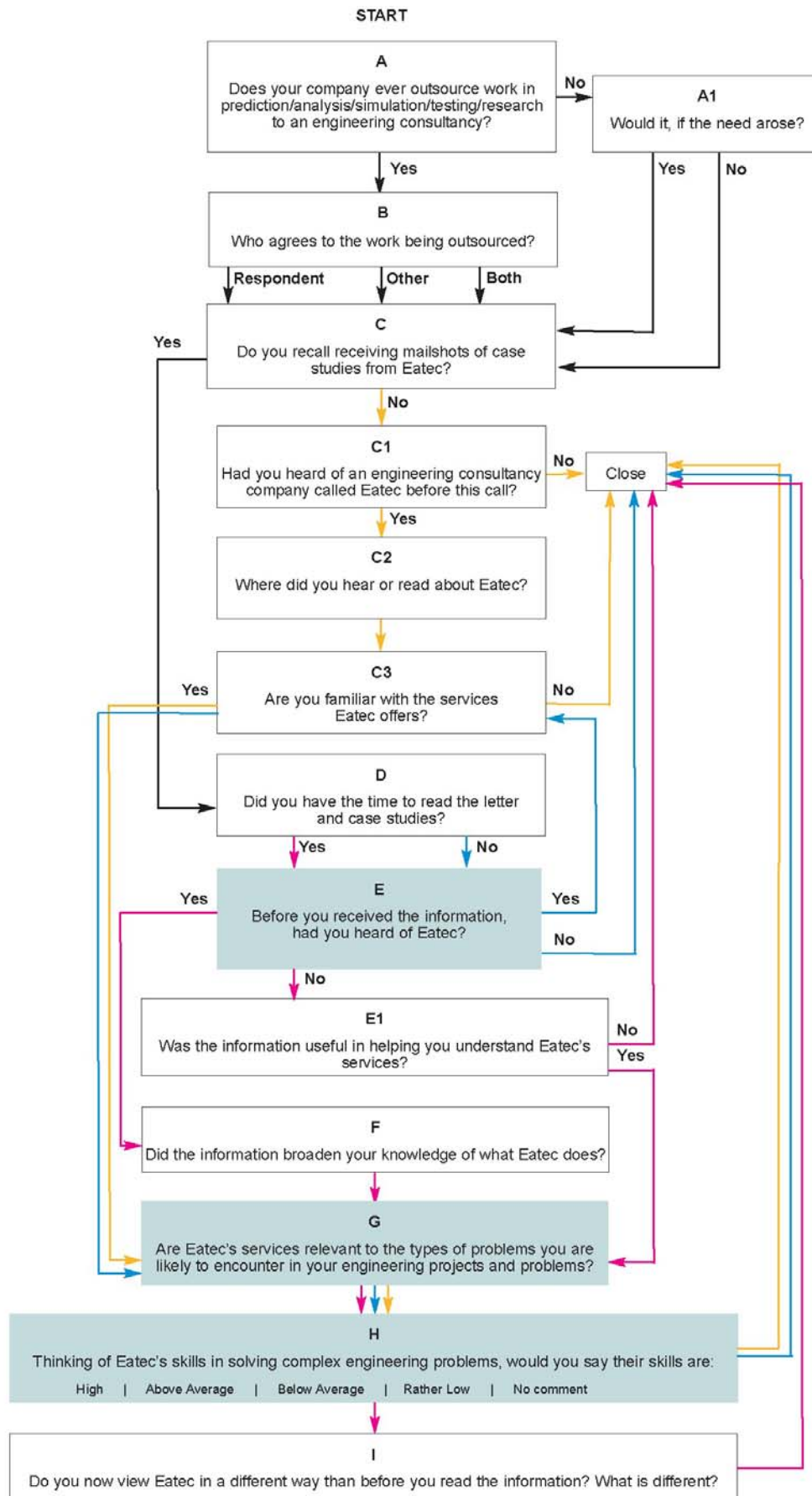


Figure 3. Questionnaire design - arranging the questions in order

Identify the form and layout

The physical characteristics of a questionnaire, such as the format, spacing, and positioning can have a significant effect on the results (Malhotra, 2005). As the questionnaire was administered by the researcher through telephone interview, it was more important that the researcher was clear about the structure and flow of the questions to be asked. The benefits of a questionnaire administered by a researcher were that queries about the meaning of a question can be dealt with, a misunderstood question may be corrected and respondents can be encouraged to provide deeper responses to open questions (Brace, 2004).

Reproduce the questionnaire and testing

The reproduction of the questionnaire (Malhotra, 2005) was carried out in the previous stage. Malhotra (2005) suggested that all aspects of the questionnaire from wording, sequence, form and layout be tested by personal interviews. This step helps to reveal potential problems in the interviewing method. The researcher tested the questionnaire on academic colleagues and staff at Eatec. On a number of occasions, the researcher got confused with the sequence of the questionnaire. The researcher was unsure about the subsequent question to go to as a result of branching and overlapping questions (Malhotra, 2005). On the questionnaire, it was too abstract to define on the questionnaire fixed instructions such as: 'If yes, go to question F; if no go to question E1'. The researcher became too focused on reading the instructions that the respondent would be left waiting.

As Clarke and Freytag (2005) states for segmentation, the general problem with developing a method that fits all is that each company will have their own individual purpose for segmenting the market: a method that works for one purpose might not be sufficient for another. The researcher felt the same principle could be applied here. Semi-structured and structured questionnaires did not quite work in the pre-testing stage and so the method needed to be tweaked slightly. The ultimate aim was so that the researcher could carry out the questionnaires effectively and without hesitation on what to ask next! The solution was that the researcher continued to use the questionnaire form to note down answers and details of the respondent. However, this must be used in conjunction with the flowchart (figure 3) as a tool to guide the researcher on the sequence of the questionnaire depending on the response of each question. The sequence of the questions would vary for each respondent. So using the flowchart as a visual guide made the interviews much easier to conduct and less restrictive as open ended questions can still be asked. Certain responses could be probed by the researcher from the discussion to explore further insights about the mailshot campaign that might not necessarily have been covered in the set questions.

Findings of the mailshot effectiveness analysis

This section discusses the findings of the mailshot effectiveness analysis. Table 3 to 5 displays the findings for each group 1, 2, 3 and 4 as well as a total result for all four groups. Where cells are highlighted green, this means it is an overlapping question as discussed earlier. Cells highlighted in grey means that the questionnaire has ended for those respondents at that point, reason which will be explained in each question analysis. The number highlighted in the grey cell is discarded from the total sample number of 51 to provide an indication on the sample size that still remained for the rest of the mailshot effectiveness research. Sample still remaining is highlighted in the last column under the heading 'sample remaining'. The 'questions' column highlights the questions that were asked. For easy reference, this table should be referred to in conjunction with figure 3, the flowchart tool that was used in conjunction with the questionnaire. As explained earlier, the flowchart was a tool to guide the researcher on the sequence of the questionnaire, which depended on the response of each question. The sequence of the questions varied for each respondent, therefore using the flowchart as a visual guide made the interviews much easier to conduct.

The results for each question is analysed and interpreted below.

highlighted cells are overlapping questions respondents discarded from sample											
Questions	Answer	Group 1 [11 out of 51]	%	Group 2 [12 out of 51]	%	Group 3 [13 out of 51]	%	Group 4 [15 out of 51]	Total 51 companies	%	Sample remaining
A Outsourcing work to an engineering consultancy? (Go to question B)	Yes	4	36%	5	42%	3	23%	3	15	29%	51
	No	7	64%	7	58%	10	77%	12	36	71%	
A1 If no to Q(A) = 36, respondents were asked 'Would it if the need arose?' (Go to question B)	Yes	5	14%	3	8%	4	11%	2	14	27%	51
	No	2	6%	4	11%	6	17%	10	22	43%	
B If yes to Q(A) = 15, respondents were asked 'Who agrees to the work being outsourced?' (Go to question C)	Respondent	2	13%	2	13%	0	0%	0	4	27%	51
	Other	0	0%	1	7%	3	20%	2	6	40%	
	Both of the above	2	13%	2	13%	0	0%	1	5	33%	
C Do you recall receiving malshots of case studies from Eattec? [out of 51 respondents] (Yes, go to question D) (No, go to question C1)	Yes	0	0%	3	6%	3	6%	5	11	22%	51
	No	11	22%	9	18%	10	20%	10	40	78%	
C1 If no to Q(C) = 40, respondents were asked 'Had you heard of an engineering consultancy company called Eattec before this call?' (Yes, go to question C2) (No, questionnaire ends)	Yes	2	5%	1	3%	1	3%	1	5	13%	16
	No	9	23%	8	20%	9	23%	9	35	88%	
C2 If yes to Q(C1) = 5, respondents were asked 'Where did you hear or read about Eattec?' (Go to question C3)	Unsure	1	20%	1	20%	1	20%	1	4	80%	16
	Advertisement	1	20%	0	0%	0	0%	0	1	20%	
C3 Are you familiar with the services Eattec offers? [sample = 5 respondents from Q(C2) and 1 respondent from Q(E) where variable was '(D) no, (E) yes'] (Yes, go to question G) (No, questionnaire ends)	Yes	0	0%	0	0%	0	0%	0	0	0%	10
	No	2	40%	1	20%	1	20%	2	6	120%	

Table 3. Mailshot effectiveness analysis questions A to C3

Questions	Answer	Group 1 [11 out of 51]	%	Group 2 [12 out of 51]	%	Group 3 [13 out of 51]	%	Group 4 [15 out of 51]	%	Total 51 companies	%	Sample remaining
D If yes to Q(C) = 11, respondents were asked 'Did you have the time to read the letter & case studies?' (go to question E)	Yes No	0 0	0% 0%	3 0	27% 0%	2 1	18% 9%	2 3	18% 27%	7 4	64% 36%	10
E If yes to question D = 7 respondents: Before you received the information, had you heard of Eattec? (Yes, go to question F) (No, go to question E1) If no to question D = 4 respondents: Before you received the information, had you heard of Eattec? (Yes, go to question C3) (No, questionnaire ends)	Yes No Yes No	0 0 0 0	0% 0% 0% 0%	0 3 0 0	0% 43% 0% 0%	0 2 0 1	0% 29% 0% 25%	0 2 1 2	0% 29% 25% 50%	0 7 1 3	0% 100% 25% 75%	7
E1 If yes to Q(D) & no to Q(E) = 7, respondents were asked 'Was the information useful in helping you understand Eattec's services?' (Yes, go to question G) (No, questionnaire ends)	Yes No	0 0	0% 0%	3 0	43% 0%	2 0	29% 0%	1 1	14% 14%	6 1	86% 14%	6
F If yes to Q(D) & yes to Q(E) = 0, respondents were asked 'Did the information broaden your knowledge of what Eattec does?' (go to question G)	Yes No	0 0	0% 0%	0 0	0% 0%	0 0	0% 0%	0 0	0% 0%	0 0	0% 0%	6

Table 4. Mailshot effectiveness analysis questions D to F

Questions	Answer	Group 1 [11 out of 51]	Group 2 [12 out of 51]	Group 3 [13 out of 51]	Group 4 [15 out of 51]	Total 51 companies	%	Sample remaining
G Are Eatec's services relevant to the types of problems you are likely to encounter in your engineering projects and problems? (go to question H)								
	Variables that lead to question G: - (D) yes, (E) yes, (F) yes = 0 respondents	Yes 0 0% No 0 0% Maybe 0 0%	0 0 0% 0 0 0% 0 0 0%	0 0 0% 0 0 0% 0 0 0%	0 0 0% 0 0 0% 0 0 0%	0 0 0% 0 0 0% 0 0 0%	0% 0% 0% 0% 0% 0%	
	- (D) yes, (E) no, (E1) yes = 6 respondents	Yes 0 0% No 0 0% Maybe 0 0%	2 0 0% 0 0 0% 1 0 0%	1 0 0% 1 0 0% 0 0 0%	0 0 0% 1 0 0% 0 0 0%	3 2 33% 1 0 17% 1 0 17%	50% 33% 17% 0% 0% 17%	
	- (D) no, (E) yes, (C3) yes = 0 respondents	Yes 0 0% No 0 0% Maybe 0 0%	0 0 0% 0 0 0% 0 0 0%	0 0 0% 0 0 0% 0 0 0%	0 0 0% 0 0 0% 0 0 0%	0 0 0% 0 0 0% 0 0 0%	0% 0% 0% 0% 0% 0%	
	- (C3) yes = 0 respondents	Yes 0 0% No 0 0% Maybe 0 0%	0 0 0% 0 0 0% 0 0 0%	0 0 0% 0 0 0% 0 0 0%	0 0 0% 0 0 0% 0 0 0%	0 0 0% 0 0 0% 0 0 0%	0% 0% 0% 0% 0% 0%	
								6
H Thinking of Eatec's skills in solving complex engineering problems, would you say their skills are: (go to question I)								
	Variables that lead to question H: - (D) yes, (E) yes, (F) yes, (G) a follow on question = 0 respondents	none 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0% 0% 0%	
	- (D) yes, (E) no, (E1) yes, (G) a follow on question = 6 respondents	high above average below average rather low no comment	1 0 0% 0 0 0% 0 0 0%	1 0 0% 0 0 0% 0 0 0%	2 0 0% 0 0 0% 0 0 0%	3 0 0% 0 0 0% 2 0 33%	17% 50% 0% 0% 33% 0%	
	- (D) no, (E) yes, (C3) yes, (G) a follow on question = 0 respondents	none 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0% 0% 0%	
	- (C3) yes, (G) a follow on question = 0 respondents	none 0 0%	0 0 0%	0 0 0%	0 0 0%	0 0 0%	0% 0% 0%	
								6
I Do you now view Eatec in a different way than before you read the information? What is different? Variables that lead to question H: If yes to (D) and (E), then a difference in respondents' perception on Eatec can be compared, before and after reading the mailshot information = 0 respondents If yes to (D) and no to (E), then a difference in respondents' perception on Eatec cannot be measured because respondent had no previous knowledge on Eatec. This follow on question (I) is therefore applicable only for variables 'I yes to (D) and (E)'								
								6

Table 5. Mailshot effectiveness analysis questions G to I

Findings from questions A to C3 (see table 3)

Question A:

Does your company ever outsource work in prediction/analysis/simulation/testing/research to an engineering consultancy?

The aim of this question was to find out if the mailshot had targeted the right companies (see table 1 for questionnaire design – determining the content of questions). The results (table 3, question A) showed that 15 out of 51 respondents answered yes and 36 out of 51 answered no. Acknowledging that the respondent's company outsourced (29% of the sample population) was good news because it suggested that there was potential for Eatec to further develop a relationship with that company. More importantly, the micro-segmentation selection process did manage to target some relevant companies and had established relevant business contacts.

Acknowledging that fact meant that question B applied in trying to find out if the correct decision maker was identified during the micro-segmentation selection process. However, where 36 out of 51 (71% of the sample population) had answered no to outsourcing work, this was not all bad news. Question A1 was designed to understand in situations like this whether the company considered outsourcing if the need arose. Even if the respondent had answered no to A1, this was a sample who had received two lots of case studies through mailshot 1 and mailshot 2 (See figure 1 for the mailshot planner). The main criteria for selecting interviewing groups were that each must have received at least two sets of mailshots in order for the questionnaire to show indicative results. Therefore, the questionnaire could still be continued for respondents who answered 'no and would not consider outsourcing' (which were 36 out of 51 respondents), because their opinion on whether they found the information useful was still valid. Moreover, where they initially responded to 'no, would not consider outsourcing', it would be interesting to see if the case studies might change their perception on outsourcing possibilities.

Question A1:

Would it, if the need arose?

The aim of this question was to find out where the company did not outsource, whether the company would consider it if the need arose. The sample in this question was the 36 respondents from question A, who had answered no to work being outsourced. Of the 36 respondents, 14 (27%) said 'yes, would outsource if the need arose' and 22 (43%) said 'no,

would not outsource even if the need arose. For these 22 respondents, it was found that the majority already had in-house capability to solve engineering problems. Therefore, outsourcing was generally not required. This meant that 43% of the total sample (22 out of the total 51 respondents) would not outsource because there already existed in-house capability. Looking at the results from table 3, it appears that the majority of respondents who said 'no, would not consider outsourcing' due to existing in-house capabilities were those from group 4 (10 out of the total 51 respondents). Group 4 companies were based around the west midland area. Group 1 had the most respondents to respond with 'yes, would consider outsourcing', a group which were of a closer proximity to Eatec. Therefore, based on these results at this point in time, Eatec should concentrate marketing efforts on developing relationships with companies closer to home. The responses to question A where companies outsourced work anyway, were groups 1 and 2 with groups 3 and 4 falling in 3rd and 4th place. This strengthens the conclusion to target companies with regions closer to home.

Question B:

Who agrees to the work being outsourced?

The aim of this question was to find out if the correct decision maker was identified during the subsequent segmentation selection process of the target clients. The sample in this question was the 15 respondents from question A who had responded with 'yes, work is outsourced'. In summary, there were three kinds of answers to this question: the respondent, another person, or both such as a joint decision. The response that ranked first in being the decision maker for work being outsourced was 'another person' (6 out of the 15 who said yes work was outsourced). In second place was 'joint decision' (5 out of the 15 who said yes work was outsourced). Finally, in third place only 4 respondents said the choice to outsource was an independent decision. This implied that out of the total 51 respondents, the micro-segmentation process had identified only 9 (18%) respondents who *played a part* (these included 'respondent' and 'joint decision with another person') in deciding work to be outsourced, 8 of which were from groups 1 and 2 and 1 from group 4. A trend cannot be drawn on such a restricted sample size, but Eatec can draw from this result at this point in time that the micro-segmentation process has at least identified some relevant contacts. This strengthens the point made above in question A and A1 that marketing efforts should target on groups 1 and 2 here forth.

Question C:

Do you recall receiving mailshots of case studies from Eatec?

The aim of this question was to find out if the information (the two sets of case studies sent in mailshot 1 and 2) sent to groups 1, 2, 3 and 4 were effective in terms of the respondents recall rate only. Acknowledging the recall rate would help Eatec understand to what extent the case studies were effective in terms of developing lasting impressions on people's minds. Secondly, it was to determine whether the mailshot approach might have been a '*waste of time*' if the results showed that very few remembered receiving the information that was specifically addressed to them. What this question does not measure is the effectiveness of the mailshot campaign in general. At this stage, the outlook on the mailshot campaign to these newly identified groups (selected through the macro and micro segmentation process) were in effect a cold calling tactic but through post not telephone. In discussion with the researcher, the directors expressed the possible factor that many recipients may treat the information sent to them as 'junk mail'. The directors had this feeling because quite often they received information in the post, where most of the time they too did not have the time to process the information or just simply 'information overload'. However, the directors did agree that they were drawn to information that had a nice professional and glossy finish. Due to this reason, it was part of the case study and mailshot design to try and include at least one piece of 'glossy' feature. This was the ExTRACT brochure included in mailshot 2 (see figure 1 for the mailshot planner), to hopefully bring about a better percentage of recall the second time round the respondents received the mailshot (enclosed at back of this report). It was discussed and agreed between the directors and the researcher that when Eatec's business development manager made a mailshot follow up call, that a better recall rate would bring about a higher response rate to the cold call. Having a better recall rate meant that in a way it would not be considered a 'cold call', but rather a follow up call to 'see if the information was useful' to the potential client.

How the use of better designed marketing material can assist with the development of new business relationships in marketing campaigns (Parker, 2002), and whether it can really help bring about a better recall rate is an interesting debate worthy of additional research, but not one necessarily germane to this research paper on business segmentation.

The results showed that 11 out of the total 51 respondents (22%) recalled receiving the mailshots and 40 (78%) did not. This implied that the mailshots only received a 22% success rate in respondents' recall of the case studies that they supposedly should have all recalled receiving. This was not a particularly pleasing result for the directors as a lot of time

investment was placed into developing the case studies, as well as resource used to plan and implement the mailshot campaign (such as material and printing costs). It was thought perhaps the difference in weeks had an effect on the recall rate. In terms of time scales (see figure 1 for mailshot planner), each group received mailshots at different times of the month as highlighted below:

	1st Mailshot	2nd Mailshot
• Group 1:	March 2003	July 2003
• Group 2:	April 2003	September 2003
• Group 3:	May 2003	September 2003
• Group 4:	June 2003	October 2003

According to the table of results (table 3), no respondents from group 1 recalled receiving the mailshots. This group last received the mailshot in July 2003, three months before the mailshot effectiveness analysis was taken place. From group 2, there was a 6% recall rate (3 out of 12 respondents). This group last received the mailshot in September 2003, one month before the mailshot effectiveness analysis was taken place. From group 3, there was a 6% recall rate (3 out of 12 respondents). This group also last received the mailshot in September, one month before the mailshot effectiveness analysis was taken place. Finally with group 4, there was a 10% recall rate (5 out of 15 respondents). This group had last received the mailshot in October 2003, a few weeks before the mailshot effectiveness analysis was taken place. These results suggest that the case studies need to be sent more regularly on a 6-8 weekly basis but that it should not lapse for more than twelve weeks at a time otherwise the recall rate drops to 0% (as demonstrated with group 1).

With reference to figure 1, all four groups received exactly the same information (CS001, CS002, CS003 in mailshot 1 and CS004, CS005 and ExTRACT in mailshot 2). Therefore, why the difference in recall rate? It has been suggested that by personalising direct mailshot can produce a higher response rate than a conventional mailshot (Prime Litho Printing Services - members of the Direct Marketing Association, 2006). It was also believed by 99% of the direct mail industry that colour is a variable that can increase direct marketing response rates (Attwood, 2006). The general belief of this is wrong and the definitive academic study on this is the article by Meyers-Levy and Peracchio (1995). Measuring how recall and response rates are affected is another interesting debate worthy of further research.

The case studies produced by Eatec were not personalised in any way that they were more appropriate to readers within groups 2 and 3 with a 6% recall rate respectively and group 4 with a 10% recall rate, but not to group 1 with a 0% recall rate. The other variables distinguishing the samples that might have had an effect on recall rates were the time scales (as explained on the previous page) and the geographic locations of the segmented client groups'. Time was a plausible explanation, but to suggest that geographical location a possible variable was unreasonable. If it was true that geographical location had an impact on the recall rate, then it meant that *companies based furthest away from Eatec were more likely to recall receiving mailshots from Eatec than those within close proximity to Eatec*, which logically was unsound.

Question C1:

Had you heard of an engineering consultancy company called Eatec before this call?

Answers to question C should ideally have been 'yes' because the respondent groups selected were those that had been sent two mailshots containing two different sets of case studies. Answering 'no' meant that the mailshot was not very effective in terms of recall rate (as explained in the analysis to question C). To overcome this limitation, the researcher developed a set of questions (C1, C2 and C3) that could be asked based on the criterion that respondents did not remember receiving the mailshot. It would be interesting to find out if these respondents might have had previous knowledge about Eatec and its services from another source such as a referral or from an advert in a publication even if they could not recall receiving the mailshots and therefore the information were not read.

The aim of this question was to find out if respondents knew about Eatec prior to this questionnaire. The target sample for this question was the 40 respondents who answered 'no' to question C. Although question C1 was potentially applicable to all 51 respondents, it was easier to split the sequence at this stage so that questions C1 to C2 addressed the feedback of the 40 respondents only who had confirmed that they had no recollection of receiving the mailshots. For the remaining 11 respondents who did recall receiving the mailshots, their response as to whether they knew about Eatec before the mailshot was addressed further down in question E.

With reference to the 40 respondents who answered 'no' to question C, table 3 shows that 5 respondents (13%) had heard of Eatec before and 35 respondents (88%) said they had not heard of Eatec before. This meant that out of the whole sample of 51 respondents, 35 (69% of the population) did not remember receiving the mailshot and had never heard of Eatec

before. At this point, the questionnaire could not be continued with these respondents and therefore were discarded from the total population, leaving 16 applicable respondents to continue with the mailshot effectiveness analysis. This did not mean that the 35 respondents discarded from the mailshot effectiveness analysis were no longer valid potential clients to Eatec. The results merely indicated that since the mailshot campaign only received a 22% recall success rate (11 out of 51 respondents recalled receiving mailshots of case studies as indicated from answer to question C), the directors may need to consider adopting additional methods of business development.

The main interest of this question was acknowledging that 5 out of the 40 respondents (who do not recall receiving the mailshots from Eatec) had actually heard of Eatec before from another source. Therefore it was useful to find out where they might have heard of Eatec before. The presumption was if these respondents did not recall receiving the mailshots, and yet they remember Eatec from elsewhere, then knowing that source would be a useful indication to alternative successful methods of business development and in raising company profile or maintaining awareness with potential clients. Thus, question C2 was designed to try and capture this.

Question C2:

Where did you hear or read about Eatec?

The aim of question C2 was to find out about alternative methods that might have been successful in raising the company's profile or in maintaining awareness with potential clients. This question follows on from C1 which was to try and establish if respondents had heard of Eatec before. Therefore respondents to question C2 were those who did not remember receiving mailshots from Eatec but had heard of Eatec before this questionnaire was conducted.

The 5 respondents to question C1 who had heard of Eatec before were further probed in this question to find out where they might have heard or read about Eatec. The answers given could be summarised as:

- 1) Not sure, the name 'rings a bell'
- 2) Advertisement in a magazine

Only 1 respondent recalled reading about Eatec in an advertisement, the other 4 respondents could not pinpoint where they had heard or read about Eatec. Eatec had consistently placed an advertisement in a professional engineering journal. The directors believed that an advertisement needs to be placed in a magazine consistently rather than as a one-off solution to quick wins. They felt that regular readers would get used to seeing the regular advertisers and would consult one of the magazines should a particular engineering service be required. The directors felt that a stop start advertising approach would do more harm as the company would not be within the readerships regular visual radar, and so subconsciously may choose to contact a company who looked familiar. It is debateable how academically justifiable this theory is and worthy of further research but not one germane to a thesis on business segmentation at this stage. Therefore, given the directors 'gut-feel' on their attitude towards advertising, it appeared that if this was true, then it explained the results for question C2. Where 4 respondents were unsure or unable to pinpoint the source of having heard or read about Eatec, it was possible that they might have come across one of the professional engineering magazines containing Eatec's advertisement. This remained to be speculated but results gained from this mailshot effectiveness analysis could only be used for exploratory purposes for this research.

Question C3:

Are you familiar with the services Eatec offers?

Question C3 was part of a set of questions (C1, C2 and C3) designed for respondents who did not recall receiving the mailshot as explained earlier. The aim of this set of question was to find out about alternative methods that might have been successful in raising the company's profile or in maintaining awareness with potential clients. This question follows on from C1 and C2 which were to try and establish if respondents had heard of Eatec before and if so, where from. Therefore, respondents to question C3 were those who did not remember receiving mailshots from Eatec but had heard of Eatec before this questionnaire was conducted. These were the same 5 respondents from questions C1 and C2.

There was also one other respondent (as highlighted in table 3 of the 'total' column, 6 respondents were highlighted) which was led to question C3 but from a different questioning sequence (see blue colour coded line in figure 3). This respondent recalled receiving the mailshot but *did* not have time to read the information. However, this respondent had heard of Eatec before and so asking question C3 was applicable. The criteria for respondents being asked the set of C1, C2 and C3 questions were that they had no recollection of receiving the

mailshots but had heard of Eatec before. Hence the respondent extended from the blue coded line met these criteria because the recollection of having received the mailshots made no difference as the information was not read anyway. No additional knowledge was gained from receiving the mailshots, but as the respondent had heard of Eatec before, it placed this respondent in the same category as the other 5 respondents that stemmed from question C1. Although question C1 is a closed ended question, the researcher could probe further if necessary depending on the respondent's answer to see where knowledge about Eatec might have been gained, even when the mailshot information was not read. This was to avoid having to go through the correct sequence of asking questions C1 and C2 as applied to the other 5 respondents. Open ended questions are difficult to manage (Pretty et al, 1995) but on a one-off occasion as such, flexibility was required and the researcher needed to be ready to adapt quickly depending on the respondent's answer in this instance.

The results for question C3 showed that none of the 6 respondents were familiar with the services Eatec offered. This suggested that even when respondents indicated that they had heard or read about Eatec before the questionnaire was conducted, they could not really pinpoint where from or further clarify the type of services offered. Not much has been concluded from this sequence of questions apart from the fact that Eatec needs to enhance efforts on raising not just the company's profile but also its capabilities to its target clients. At this stage, 6 more respondents can be discarded from the interviewing sample, which leaves 10 respondents for the remainder of the mailshot effectiveness analysis.

Findings from questions D to F (see table 4)

Question D:

Did you have the time to read the letter & case studies?

The aim of this question was to find out if the respondents read the case studies. There were 11 respondents from question C who remembered receiving the mailshots. Therefore, as a follow on from question C, question D was asked to distinguish who had and had not read the information. Subsequently, relevant questions can then be applied to distinguished groups. With reference to table 4, it appeared that there was a discrepancy between the respondent numbers to question D highlighted in the 'total' column (total of 11 respondents for question D) and with the remaining sample number highlighted in the 'sample remaining' column on the right (10 respondents). The difference in sample number needs to be clarified at this stage before continuing with the analysis.

The complexity of having branching questions is highlighted here. Question C was a branching question where the sample was split to two groups: those who recalled the mailshot (11) and those who did not (40) which subsequently followed different sequence of questions. Those who did not recall receiving the mailshots followed sequence C1, C2 and C3, the results of which have just been analysed in the previous pages and in conclusion to question C3, all 40 respondents had been discarded from the questionnaire sample. Those who did recall receiving the mailshots followed on from question C to question D and E. Question E was another branching question which resulted with 1 particular respondent who did not have time to read the mailshot information but had heard of Eatec before. This respondent which branched off from question E was already acknowledged in the analysis for question C3 because questions were analysed in chronological order (A to I), but as highlighted respondents may not necessarily follow the same chronological order in terms of the sequence of questions. Hence the reason why table 4 showed a total of 6 respondents for question C3, and question D a total of 11 respondents when the sample remaining column noted 10 respondents remaining in the total interview sample.

The results for question D showed that out of the 11 respondents, who remembered receiving the mailshots, 7 respondents had read the information and 4 had not read the information. This meant that out of 51 randomly selected professionals, the case studies received a 14% readership success.

As a managerial exploratory exercise, if we assume that for every 50 mailshot sent out, 7 people read it the readership success rate is 14%.

This can be expressed as:

$$(7/50)*100 \text{ or } (b/a)*100$$

a = how many mailshots sent

b = how many people reads it

$$c = \text{success rate} = (b/a)*100 = 14\%$$

If:

d = number of groups

e = the average* number of people in each group

*(*an average number is used as number of people in each group may differ)*

The total number of people is (d*e) or (de) in algebra terms. So to find out the number of potential clients to read the mailshots is (b/a)*100 of (de) the total number of people.

Thus the formula is:

$$(de)*((b/a)*100) \text{ or } (de)c$$

Below is an example of applying this formula when all of Eatec's mailshot groups are considered:

d = number of groups = 11

e = the average* number of people in each group = 150

**the number of people in each mailshot group varied but on average there were about 150 people in each group*

$$= (de)c$$

$$= (11 \times 150) \times 0.14$$

$$= 231$$

Therefore, based on this formula, 231 potential clients out of a total 1650 mailshots sent out would be read. This is assuming we are satisfied with using **c** as our success rate, in this case it was 14% **(b/a)*100**. Other managers who wish to apply a formula to find out an assumed

number of potential clients to read mailshots can use **(de)c** where d and e changes to suit different case and (c) is 0.14.

However, the researcher must stress at this point that 0.14, which is (c) , **is the success rate found for this case study only**. It is a constant figure that changes case by case. This research found that for every 50 mailshots 7 were read. To develop a statistically significant readership success rate of (c) is to carry out several studies highlighting ‘for every mailshot sent, how many is read?’. This would be a time consuming task and not one the researcher could do given the limited time and resource. It is also not a research directly applicable to the focus of this thesis but is certainly worthy of a follow up study to develop a readership success rate benchmark to apply to (c) to suit different managerial situations.

To increase the success rate (c) : $c = (b/a)*100$ is to increase a and b . Variable (a) can be changed by increasing the number of mailshots, but (b) , how many people reads it, is dependent on finding out ‘what makes people read mailshots?’ There was insufficient time to carry out such a study, but some possible factors could include:

- Improve the quality and appearance of mailshots (Parker, 2002; Attwood, 2006)
- Personalise mailshots (Prime Litho Printing services, 2006) such as by designing case studies split by sectors (oil and gas, processing etc)
- Carry out further micro-segmentation selection to provide specific case studies to specific target clients only. This would be extremely time consuming. For a small company like Eatec with no initial background on segmentation or strategic marketing planning, should start off on an easier footing using convenient macro variables (Hague, 2002), which are generally easier to identify and access.

Another factor to take into consideration is that these are results for a sample of 50, randomly selected from a total of 1650 potential clients (from all 11 groups) to participate in this mailshot effectiveness analysis. There could potentially be many uncontrollable variables that could affect this result. The only way to be fair was to interview all 1650 clients who would have received 2 mailshots and then draw up another analysis. Although ideal and probably provide more significant results, it is not feasible due to limited time and resource.

There are no strong statistical conclusions to suggest that having a high readership success rate implicates on an increase in business. Therefore, conclusions to this question are appropriate for exploratory purposes and under individual discretion only.

Question E:

Before you received the information, had you heard of Eatec?

The aim of this question was to distinguish from the group of respondents who recalled receiving the mailshots, those who had heard of Eatec before receiving the information and those who had not. If respondent had heard of Eatec before, subsequent questions would aim to find out if there were any before and after differences in terms of knowledge about Eatec once the information was read.

Question E was an ‘overlapping’ question. Table 4 highlights the two scenarios of question E. If respondents answered ‘yes’ to question D “*Did you have time to read the letter and case studies?*” then there were 7 respondents to question E. If respondents answered ‘no’ to question D, then there were 4 respondents to question E. Looking at the results for the former, it appears that there were no respondents who had read the mailshot information and had heard of Eatec before. If there were, these respondents would subsequently have followed on to question F. This means there were 7 respondents who had read the mailshot information but had not heard of Eatec before. This set of respondents was then probed on their understanding about Eatec’s services following their review of the case studies. This is discussed in question E1 later on. With regards to respondents who answered no to question D (4 respondents), there was 1 who had heard of Eatec before and 3 who had not. Table 4 showed that there was 1 respondent who had heard of Eatec before. This respondent had not read the mailshot information so it made more sense to probe more on the respondent’s familiarity of the services Eatec offered based on existing acknowledgement, which leads this respondent to question C3. Finally, for respondents who answered ‘no’ to question D and had not heard of Eatec before, this meant that all relevant questions have been exhausted and at this stage, 3 respondents were discarded from the population sample, leaving 7 respondents remaining for the continuation of the questionnaire.

Question E1:

Was the information useful in helping you understand Eatec's services?

This question applied to respondents who had read the case studies but had not heard of Eatec before. The aim of this question was to find out if the case studies were useful and informative to the respondents. The sample to this question was the 7 respondents from question E. Table 4 showed that 6 respondents found the case studies useful. Based on this, it was appropriate to probe on whether the types of engineering problems highlighted in the case studies were likely to be encountered in the respondents' projects or line of work. Subsequently, question G followed, the results of which is discussed in the analysis to question G later on. Question F was skipped because this question only applied to respondents who had read the case studies and had heard of Eatec before. The aim was to find out if the case studies might have broadened the respondents' knowledge about Eatec, but as explained in the analysis to question E, there were no respondents who fitted this criteria. Finally, there was 1 respondent (which made up the total of 7 respondents to this question) who had read the case studies, had no previous knowledge about Eatec but did not find the case studies to be useful or of any relevance. At this point, all relevant questions have been exhausted for this respondent so was discarded from the population sample, leaving 6 respondents remaining for the continuation of the questionnaire as highlighted in the 'sample remaining' column to question E1 (table 4).

Question F:

Did the information broaden your knowledge of what Eatec does?

Unfortunately, this question did not apply to any of the respondents, as explained in the analysis to question E and F because no respondents fitted into the criteria where the case studies were read and that the respondent had previous knowledge about Eatec. If there were relevant respondents, the analysis to this question could have provided useful feedback on the case studies developed by the directors, which would assist with future improvements.

Findings from questions G to I (see table 5)

Question G:

Are Eatec's services relevant to the types of problems you are likely to encounter in your engineering projects and problems?

The aim of this question was to find out if the problems laid out in the case studies simulated any of the engineering problems, which the respondents faced in their work. Question G is an overlapping question as indicated by the flowchart (figure 3) and table 5. This meant that potentially respondents leading to this question could have come from different sequence of questions (as shown by the blue, orange and pink colour coded lines on figure 3). Table 5 shows that only one sequence of questions eventually lead to this question. These were respondents who:

- 1) had time to read the case studies
- 2) had not heard of Eatec before
- 3) the case studies were useful

Based on these criteria, the results showed that:

- 3 respondents found that the problems highlighted in the case studies *were relevant* to those experienced in their own work.
- 2 respondents found that the problems highlighted in the case studies *were not relevant* to those experienced in their own work.
- 1 respondent found that the problems highlighted in the case studies *maybe relevant* to those experienced in their own work.

Including the respondent who responded with 'maybe relevant', the results suggest that only 4 respondents out of the 51 questionnaire sample had recalled receiving the mailshots, had spent time reading the mailshots and actually found the case studies useful and of relevance to the respondents' own work. This is the ultimate result the directors could have hoped for as it meant that the segmentation evaluation and selection process has achieved a needs/benefits approach (Bonoma and Shapiro, 1984) for these 4 respondents, the 'ultimate target clients'.

Using the readership success rate formula proposed earlier on: $(b/a)*100$, we can assume that the success rate for targeting the ‘ultimate target clients’ (clients selected through the macro and micro segmentation process) can be calculated as follows:

$$c = (b/a)*100$$

$$c = (4/51)*100$$

$$c = 8\%$$

Applying this success rate (c) to all of Eatec’s mailshot groups using $(de)c$ (a formula proposed on page 185 to find out the number of ultimate target clients the directors could potentially reach using the mailshots) would give:

$$d = \text{number of groups} = 11$$

$$e = \text{the average* number of people in each group} = 150$$

**the number of people in each mailshot group varied but on average there were about 150 people in each group*

$$= (de)c$$

$$= (11 \times 150) \times 0.08$$

$$= 132$$

Therefore, based on this formula, 132 potential clients out of a total 1650 mailshots sent out would reach the ultimate target clients (clients who would find the case studies useful and of relevance to their own work). As highlighted in the analysis to question D, these results can only be used for exploratory purposes only due to the restricted sample size this analysis was carried out. Using all mailshot groups as the sample to carry out this analysis would provide much more significant results but not feasible due to limited time and resource.

Question H:

Thinking of Eatec’s skills in solving complex engineering problems, would you say their skills are:

High / Above Average / Below Average / Rather Low / No comment

The aim of this question was to find out people’s perception upon reading the case studies. Acknowledging respondents’ perception would assist the directors to make improvements to the case studies. Question H is an overlapping question as indicated by the flowchart (figure 3) and table 5. This meant that potentially respondents leading to this question could have

come from different sequence of questions (as shown by the blue, orange and pink colour coded lines on figure 3). Table 5 shows that only one sequence of questions eventually lead to this question. These were respondents (the same 6 respondents to question G) who:

- 1) had time to read the case studies
- 2) had not heard of Eatec before
- 3) the case studies were useful

Based on these criteria, the results showed that:

- 1 respondent rated Eatec's skills to be high based on the case studies they had read
- 3 respondents rated Eatec's skills to be above average based on the case studies they had read
- 2 respondents preferred not to rate Eatec's skills based on the case studies they had read

These are only opinions based on 6 respondents, 4 of which can only be assumed because the other 2 comments were 'no comment'. However, we can conclude that all feedbacks were positive meaning that the case studies had been successful in illustrating technical competence to target clients on how engineering problems can solved by Eatec using a number of services and skills offered in-house.

Question I:

Do you now view Eatec in a different way than before you read the information? What is different?

There were no respondents leading to this question. Comparisons between the before and after differences of having read the case studies can only be carried out if the respondent had previous knowledge about Eatec before they received the mailshot. On top of that, respondents would need to have read the case studies and then be able to give an opinion on the change in perception. This would have been very difficult to achieve at this early stage of Eatec's development of a strategic marketing plan and segmentation. However, it is a valid question for later stages when Eatec carries out another mailshot effectiveness analysis once a few more mailshots have been carried out.

Feedback from clients using the mailshots tearaway response slips

Up until November 2003, groups 1, 2, 3 and 4 received two lots of mailshots and groups 5 and 6 received one lot of mailshot. Around this time, shortly after the mailshot effectiveness analysis was carried out, Eatec received 17 feedback slips. Since these were coded, it was possible to see which groups had responded to the mailshots. Of the 17 responses, 2 were qualified leads and had asked Eatec for a meeting and 2 were positive responses. The 4 respondents that either requested meetings or wanted more information were either from groups 1, 2, 3 or 4 because the feedback forms were referenced with 'CS/2' meaning (second mailshot).

Up until November 2003, only groups 1, 2, 3 and 4 had received the second lot of mailshot. Therefore, it took two sets of mailshots within the space of approximately six months to receive 4 responses from a total of 676 (figure taken from table 4.11 in the main body of the thesis) mailshots sent out. Using the earlier success rate formula:

$$c = (b/a) * 100$$

$$c = (4/676) * 100$$

The results give a success rate of approximately 1%. These are not particularly impressive figures, but when the researcher discussed this with the directors, the conclusions were that on average one new business lead could bring in a fee value of approximately £5,000 - £8,000 to the company (Brian Jarvis at Eatec, November 2003). If Eatec were successful in winning the business from the two qualified leads obtained from the mailshot, this would suggest that in a six month period, Eatec could potentially gain a £10,000 - £16,000 increase in business. Therefore, optimistically in one year, Eatec's increase in business could be £20,000 - £32,000. Based on Eatec's current turnover of £650,000, the mailshot would therefore bring in an increase of 3% - 5% in total turnover. These suggestions were based on achieving at least 4 qualified leads over one year.

Summary and lessons learnt from 'implementation' phase

The directors wanted to achieve a business increase of 15 to 20 percent over the next two to three years. To achieve this, the directors had defined a set of company objectives, as highlighted in table 4.1 in the main body of the thesis.

The findings in the implementation study suggested the following success and response rates:

Success rate	Criteria	Source
14%	Mailshot read	Analysis to question D
8%	Mailshot read Relevant to recipient	Analysis to question G
1%	Mailshot read Relevant to recipient Direct request for meeting or more information	Mailshot feedback slips

Eatec had never instigated a strategic marketing plan before. Moreover, with limited resource, it is to be expected that as a first attempt, the process would be at a slower pace. Rather than perceiving the slow segmentation progress an under achievement, the whole exercise should be embraced as an action learning process. Through this action learning approach, the directors were able to develop further knowledge and understanding in three areas: their business, clients and the marketplace.

In terms of their business, developing the case studies was an opportunity for the directors to reflect on the success of their projects, discover their strengths and think about how to best present this to the target client. In terms of clients, creating a mailshot planner meant that the target client groups evaluated and selected in the segmentation processes had to be put to use in some form. Devising a mailshot planner (figure 1) avoided a common breakdown at the implementation stage where most organisations have found it difficult to know what to do next. Dibb and Simkin (1997) stressed that having systems in place helps to communicate the intelligence to those making decisions on strategy. In this instance, the 'system' in place instigated the need to carry out a mailshot effectiveness analysis to communicate marketing intelligence back to the directors. With information from the planner and results from the mailshot effectiveness analysis, the company could identify:

- who was sent what (mailshot planner)
- how many sets of information was sent (mailshot planner)
- when was it sent (mailshot planner)
- did the time scales have any impact in the response (mailshot effectiveness analysis)
- how regularly should the information be sent (mailshot planner and mailshot effectiveness analysis)

The marketplace is not static. No sooner has a segmentation study been conducted, than it is out of date and continues to decay (Palmer and Millier, 2004). Therefore, if resource permits, the directors should be carrying out regular questionnaires to review client response, perceptions and what is happening in the markets that clients operate in. The systems in place to assist the directors is the questionnaire devised as used for the mailshot effectiveness analysis together with the flowchart (figure 3) as a tool to guide the interviewer on the sequence of the questionnaire depending on the response of each question. The sequence of the questions would vary for each respondent. So using the flowchart as a visual guide would make the interviews much easier to conduct and less restrictive as open ended questions can still be asked. Thus, with this action learning experience, the directors are therefore able to consider the interaction between the opportunities for segmentation against the feasibility of implementation (Palmer and Millier, 2004).

Palmer and Millier (2004) showed from their studies that segmentation was a difficult and demanding process, which was apparent in this study with Eatec. The benefits in both cases was that by facilitating managers through the segmentation process, managers were “learning by doing”, and by a process of induction generated worthwhile solutions and learning points (Palmer and Millier, 2004) as highlighted above.

After segmentation

This stage extends beyond the researcher's time with the company. Hence, the researcher was not able to comment on the process hereafter. However, the researcher supports Dibb and Simkin (1997) in the view that segmentation by itself is not useful; it needs to be implemented back into the whole strategic plan. This suggests that the directors should aim to carry out regular mailshot effectiveness analysis or other forms of effectiveness analysis so that any positive or negative approach can be fed back into the strategic marketing and segmentation process with the appropriate amendments. The segmentation plan (figure 4.1 as discussed in the main body of the thesis) should be a 'living' process because the marketplace is not static. Therefore, if resource permits, regular questionnaires or alternative forms of monitoring to review client response, perceptions and what is happening in the markets that clients operate in should maintain Eatec's competitive advantage.

The researcher had set about a system in place to assist the directors should they wish to carry out a follow up survey on mailshot effectiveness. The questionnaire devised together with the flowchart (figure 3) would help future facilitators within Eatec. Through the researcher's experiential learning, the study has found that the sequence of questions within the questionnaire was dependent on the respondents answer. Hence, using the flowchart as a visual guide would make the interviews much easier to conduct and less restrictive as open ended questions can still be asked. From the directors' point of view, this action learning experience has enabled them to consider the interaction between the opportunities for segmentation against the feasibility of implementation (Palmer and Millier, 2004).

Through the segmentation processes, Eatec has begun to identify clients to develop into key accounts as discussed earlier. The ideal situation for Eatec is to have a relatively small number of clients who have a significant on-going requirement for technical support. This requires Eatec to win the confidence of the client on the basis of an initial project, and then to develop that relationship by introducing new services whilst addressing other requirements within the company.

The researcher did some initial literature review on the topic of key account management and found suggestions that it is an area pivotal to a compound success in a market (Abratt & Kelly, 2002) and perceived as a supplier's relationship marketing program focusing on a single customer (Wengler, Ehret & Saab, 2006). The benefits of a primary focus on a single customer or key account management are to develop intercompany relationships. In this latter part of the segmentation process, the directors will need to work on relationship building.

The researcher reviewed Zolkiewski and Turnbull (2000) analysis on various relationship portfolio models in the context of business-to-business marketing. Although they did not suggest which of the portfolio models were best suited to this purpose, the concept provided the key to successful relationship management and important inputs to strategic management. It is up to the managers' discretion to determine which model and which mode of analysis is most pertinent to the situation (Zolkiewski and Turnbull, 2000). With this in mind, although it is not within the aim of this research to go in-depth in analysing the various relationship portfolio models, one portfolio model does appear to be useful to help the directors assess potential clients in light of a relationship portfolio analysis and determine which relationships need developing and/or maintaining and which, if any, need to be broken (Zolkiewski and Turnbull, 2000).

Zolkiewski and Turnbull (2000) argued that a three dimensional analysis based upon cost to serve, net price (or profitability of client) and relationship value is appropriate when segmenting the customers of any firm because it provides a more comprehensive overview than can be gained from using two variables as proposed in the other relationship portfolio models. The table below shows their model.

Relationship value	Profitability of client	Cost to serve
Low	Low	Low
Low	Low	High
Low	High	Low
Low	High	High
High	Low	Low
High	Low	High
High	High	Low
High	High	High

Table 6. Segments of the Zolkiewski and Turnbull (2000) Matrix

Zolkiewski and Turnbull (2000) emphasised that models described in the paper are best seen as a range of tools and methods which are best developed using managerial judgement rather than academic suggestion. In light of this view, Zolkiewski and Turnbull's (2000) Matrix can be adapted so that the relationship portfolio analysis is more substantial to Eatec's situation since a rating using 'high' and 'low' is too vague.

The researcher has adopted fictitious data to illustrate how Eatec might be able to use Zolkiewski and Turnbull's (2000) matrix with weighting scales from 1 to 5 instead of a simple high/low scale (table 7). The total summed score (the higher the better) would give the desirability level of each customer. The weighting scale for 'cost to serve' would have to

be reversed in (1=high rather than 1=low) because a customer would be more favourable if it were less costly to serve. Using numerical data to rate each client relationship value, profitability and cost to serve enables an initial analysis on customer portfolio to aid decision making processes. The examples below highlight various customer scenarios.

Customers	Relationship value	Profitability of client	Cost to serve	Total score
	1 = low 5 = high		1 = high 5 = low	
A	2	2	2	6
B	1	2	4	7
C	3	4	1	8
D	2	5	5	12
E	4	2	2	8
F	5	2	4	11
G	5	4	1	10
H	4	5	5	14

Table 7. Illustration of how Zolkiewski and Turnbull's (2000) Matrix can be used in Eatec's situation

- **Customer H obtained a high score of 14**
 - High weighting in relationship value and profitability and low cost to serve
 - An ideal portfolio
- **Customer G obtained a relatively high score of 10**
 - High weighting in relationship value and profitability but costly to serve
 - Good key account to maintain, develop more of these type of customers
- **Customer A obtained a low score of 6**
 - Low weighting relationship value and profitability and costly to serve
 - Not an ideal portfolio
- **Customer E obtained a moderate score of 8**
 - High relationship value, low profitability and costly to serve
 - Unless the relationship value is vital to future business, this portfolio is not the most ideal type to obtain

It is, as Zolkiewski and Turnbull (2000) stressed, that the management's discretion is key in the use of these analysis tool and any model described should be used alongside managerial judgement (Zolkiewski and Turnbull, 2002). This matrix (table 7) would work well with Eatec in understanding individual client portfolio as small businesses generally follow a much less complex process in decision making as illustrated in the thesis research.

Analysing the implementation stage following the segmentation process

The implementation stage was considered by the directors to be the most important stage because the fundamental of developing a strategic marketing and segmentation plan was to improve company profits. Growth is based on the reputation of the company and firmly on personal relationships between the client and the professional (CIM, 2007). The directors recognised this and were keen to implement the mailshot campaign. It was felt that the campaign could develop a higher client response rate when follow up calls were made to 'see if the information was useful', as opposed to cold calling with no initial marketing communications established. Through the initial 'mailshot follow up' telephone call, the directors could begin the process of building the foundations to establishing a firm relationship with the client.

The directors had felt that the segmentation process took too long. The directors knew strategically which markets and clients to target following the segmentation process but operationally they were unsure how or what they were going to do to establish relationships with the potential client. The researcher identified that the company needed a plan of action, marketing tools and some sort of measure to find the effectiveness of the strategies implemented. This aligns neatly with the latter part of the segmentation process of Goller et al's (2002) framework. Goller et al (2002) highlighted in this framework that the implementation of segmentation was the need to integrate the findings into strategy, and in order to keep control of the segmentation process was a need to understand the effectiveness of the implemented marketing strategies. The researcher agrees with Goller et al (2002) and in Eatec's case, this process was followed. **project case studies for mailshots**

The need for marketing tools (to send out as mailshots) meant that project case studies were developed. This was a direct managerial action because the case studies needed to be written by a technical person illustrating how an Eatec service provided solution to a particular engineering problem experienced in a specific industry. The researcher's background was in marketing not engineering and so was not able to assist with the writing of the case studies. However, the researcher did facilitate with the desktop publishing of the final piece, a task that was of equal importance.

Albeit to whether better designed marketing materials would assist with the development of new business relationships in marketing campaigns (Parker, 2002) is debatable. However, a simple test in this case revealed that the directors themselves (who indicated that they never had time to read marketing information that was sent to them) had preferred a visually well presented case study as opposed to a business development letter. The directors also revealed that they were more inclined to 'pick one up to read' if it were printed on good

quality paper. These points were taken into consideration when the researcher designed the layout of the case studies. The case studies were printed in high resolution on slightly glossy heavy paper and an example of a typical Eatec case study layout is enclosed in the back of this report.

The mailshot planner

An informative planner was an essential tool for the researcher to facilitate this part of the segmentation process. The conclusion was that market planning leads to effective market implementation, which enabled the researcher to know when more case studies, need to be created and when they need to be sent. The colour coding on the planner defined mailshots that were sent and those that need to be written. Hence, the development of this mailshot management tool enables Eatec to remain functional even after the departure of the researcher/facilitator.

Kotler and Keller (2005) noted that for marketing to be effective, the organisation needs to have adequate information and marketing tools for planning and allocating resource to different markets, products or territories. With this in mind, having a good management tool is good practice and the mailshot planner was devised specifically for this purpose to assist the directors at an operational and strategic level in the segmentation implementation stage.

Keeping control of segmentation

The literature states that the underlying logic of segmentation is so that any marketing carried out is effective (Beane and Ennis, 1987; Weinstein, 1987), but the underlying logic in the real world in this case was whether the mailshot worked for the company. Goller et al (2002) highlighted that some sort of control is needed to maintain a successful segmentation programme. Although what exactly does successful and effectiveness mean? The main aim of the research was predominantly to understand more about the process of segmentation, in particular the evaluation and selection process, but the researcher had felt it necessary to gain some academic understanding of definitions on effectiveness within the segmentation context.

Effectiveness and efficiency works hand in hand (Mouzas, 2006) where effectiveness looks at the company's ability to design a model to embrace business opportunities through exchanging relationships, efficiency looks at the internal issues such as operational excellence or productivity. Hence, to understand the effectiveness of the marketing strategy adopted by Eatec was to look at the model used to embrace new business opportunities.

Therefore, understanding efficiency in this case could not be neglected. Efficiency in this research meant understanding the internal issues such as operational excellence that contributed to maintaining the segmentation programme. In this case it was predominantly the researcher who acted as a facilitator; a dedicated resource focused on doing the segmentation job, thus maintaining operational excellence.

The questionnaire design process

Malhotra (2005) provided a useful step by step guide to the process of designing a questionnaire. The design of the mailshot effectiveness questionnaire followed a similar process but the researcher found that not all steps were necessarily followed in such a linear process.

The first step was to specifying the information needed from the survey. In order to find out if the segmentation process implemented was successful, the directors wanted to find out:

- 4) if the decision maker found the mailshot relevant and useful
- 5) if Eatec had targeted the right companies
- 6) if the companies were likely to use Eatec's services

Although there was a total of 11 groups, only 4 had fitted in the criteria of being in the survey sample. It was agreed with the directors that groups must have received at least two lots of mailshots because it was assumed that the first set of mailshot received might be regarded as 'new information' to the recipient and so recollection of the context may be weak. It was regarded that receiving a second set of mailshot might bring about recollection upon the recipient regarding Eatec and its services. At the time the research was undertaken, only 4 groups had received a second lot of mailshot, so only 4 groups formed the survey sample. This was still a relatively large group for the researcher to carry out a mailshot effectiveness analysis in the limited time left of the researcher's contract time. Hence, the sample size was adjusted so that it became a manageable total of 51 respondents.

Specifying the type of interviewing method was straight forward because respondents expanded across a large geographic area, so the only feasible options were either mail questionnaires or telephone interviews. Given that mail surveys are only half as effective as telephone surveys in generating a response (Wittink and Cattin, 1989), the researcher settled on the telephone interviewing method as the most efficient way of obtaining respond from all 51 respondents.

At this point, the researcher moved away from the linear process of Malhotra's questionnaire design guide. Palmer and Millier (2004) writes that the application of complex, linear and step-by-step guidelines for managers may be inappropriate, but this was in the context of segmentation because users operated in different and constantly changing environments, one in which development, learning, and feedback loops all exist. However, the researcher found this also to be true in the design of the questionnaire. The process of compiling this 'questionnaire tool' encompassed a flow of thinking similar to that suggested by Palmer and Millier (2004), where the researcher developed the content, learned about different ways of wording the questions, how it were to be structured into a flow of questions. This experience was then reflected back into the process to complete the learning cycle until an appropriate set of questions were developed.

The researcher found it initially difficult to arrange the questions on paper in a logical order due to a number of branching questions (Malhotra, 2005). Depending on the answers given, this would have had an effect on the order of subsequent questions. The solution for this case was the use of colour-coded lines and the use of a flow diagram, which illustrated Palmer and Millier's (2004) concept of development, learning, and feedback loops. This process of experiential learning reflected Kolb's learning cycle (1984) because the combination of perceiving and processing determines the learning styles that make up a learning cycle.

Mailshot effectiveness analysis

So what do these results mean? The marketing objective was to achieve a business increase of 15 to 20 percent over the next two to three years. At the time of the research, it was too early to be able to measure whether Eatec's strategic marketing and segmentation process delivered this objective. However, the aim of the mailshot effectiveness analysis was to look for indicative results to see if the process in place would align the business towards achieving that goal.

The survey concluded that 15 out of 51 respondents (selected as a result of the segmentation process carried out in stage 1 and 2 of Eatec's strategic marketing and segmentation process) outsourced their engineering requirements. This meant that the micro-segmentation evaluation and selection process had been successful in identifying new companies to enable the directors to embrace new business opportunities (Mouzas, 2006). Findings from question A1 also suggested that the majority of those who would outsource were from groups based in geographical regions closest to Eatec in the south west, and very little from companies

based in the midlands. It could be coincidental the fact that very little respondents from the west midland (group 4) said they would outsource or it could be because respondents from group 4 wanted to deal with a company that was closer to home. Hence, responding with “no, would not outsource” was a more polite way of saying so.

The subsequent segmentation process to identify target client lists was but did the process succeed in identifying the right contacts? This question was dealt with in question B. The survey probed on those who said would outsource and found that over half of the respondents were the decision makers. Again, the majority of those decision makers were from groups based in geographical regions closest to Eatec in the south west. Further statistical conclusions could not be drawn on such a restricted sample size but the assumptions were debatable. It would be interesting to further explore if location was a factor in clients choosing who to work with. Due to limited time, this was not possible.

The results found in questions A, A1 and B highlights if the segmentation was successful. The subsequent analysis concentrated on question C to understand if the mailshots were successful in creating business leads.

Unfortunately, the recall rate of respondents who received the mailshots was only 22%, but as expected, the recall rate deteriorated depending on the last time the second set of mailshot was received. Group 4 with the highest recall rate had last received the mailshot in October 2003. This was only a few weeks before the survey was conducted. In comparison, group 1 had no recall rate and the last time this group received a mailshot was July 2003, three months before the survey was conducted. These results suggested that ‘time’ was a factor that had an effect on the recall rates. This meant that mailshots need to be sent regularly on a 6-8 weekly basis (or until Eatec had established sufficient contacts in the sectors) and that it should not lapse for more than twelve weeks at a time, otherwise the recall rate drops to 0% (as demonstrated with group 1).

The findings from questions C1 and C2 suggested that the segmentation process captured some potential clients who had heard of Eatec before. Although this number was minuscule in proportion to the actual sample size, it was found that the alternative source to potentially help Eatec gain client awareness was through advertising in professional journals. The views of the directors were that regular advertising is important (if one were to decide on this strategy to raise company awareness) and that the advertisement would need to be placed on a regular basis to remain on the reader’s visual radar, otherwise a ‘stop/start’ advertising approach would not be very beneficial unless it was featured with an editorial.

As quoted by one of the director: *“If you have been advertising regularly and then suddenly stop advertising, it might give people the impression that there is something wrong with the company. Or if they were used to seeing the advert, and when they do need your service and you’re not there in the back of the journal, they’ll just go to someone else.”* (Director at Eatec Ltd, 2003).

It is debateable how academically justifiable this theory is, but the directors felt this was why for the case of question C2, that some respondents had heard of Eatec before but were unable to pinpoint the source, it has been on the reader’s visual radar.

Following this, Eatec continued with the advertising, which was part of a public relations strategy to raise the awareness and communication of Eatec in the right market sectors. The researcher had sought advice from the public relations officer at the University of Bath and had developed a draft public strategy for the directors to review (enclosed at the back of this report). From speaking to the public relations officer, the researcher was provided some source to carry out a journal review (enclosed at the back of this report) to assist the directors in deciding future publication features as part of the public relations strategy. The researcher also designed a new advert for Eatec (enclosed at the back of this report) to highlight particular services to place within chosen publications. The researcher had reviewed other existing advertisements in different engineering publications before drafting a layout for Eatec so that the advertisement stood out from competitors and that it communicated the right message across by highlight the right services.

The crucial key question remained from the directors’ point of view: were the mailshots read and would they generate business leads? In a nutshell, out of the 51 respondents interviewed, 14% read the mailshots (findings from question D) and 8% (findings from question G) had found the mailshots relevant to them. In actual fact, out of the 4 groups who received 2 mailshots at the time this research was carried out, Eatec only received 1% response (from the response slips which were coded and attached to the mailshots) that were potential leads.

In terms of figures, if Eatec were successful in winning the business from the two qualified leads obtained from the mailshots, it would suggest that in a six-month period, Eatec would potentially gain a £10,000 - £16,000 increase in business. Optimistically in one year, Eatec’s increase in business would be £20,000 - £32,000. Based on Eatec’s turnover at the time of this research (which was £650,000), the mailshot would create a business increase of 3% - 5% in total turnover.

These suggestions were based on achieving at least 4 qualified leads over one year. These results were far from the 15-20% increase in which the directors had hoped for. However, the benefit of the doubt was that these results were only for 4 groups. There were a total of 11 groups, plus the mailshot had only been ongoing for six months. Rather than concluding the process to have under achieved expectations, the whole exercise should be embraced as a valuable action learning process. Through this action learning approach, the directors were able to develop further knowledge and understanding in three areas: their business, clients and the marketplace.

Findings from question D also enabled the researcher to develop a simple success rate formula for the directors to use each time they carried out a mailshot campaign. The success rate formula can be expressed as:

a = how many mailshots sent

b = how many people reads it

c = success rate = $(b/a)*100$

Subsequently, the number of potential clients to read the mailshots would be expressed as:

d = number of groups

e = the average* number of people in each group

*(*an average number is used as number of people in each group may differ)*

$(de)*((b/a)*100)$ or $(de)c$

The researcher highlighted that if a success rate were to be increased (c): $c = (b/a)*100$ then it would be necessary to increase *a* and *b*. As was explained in the findings to question D, variable (*a*) could be changed by increasing the number of mailshots, but (*b*), how many people reads it, was dependent on finding out ‘what makes people read mailshots?’.

Although the main focus of the research was not to research on what makes mailshot material successful in bringing about better recall rate, the researcher has suggested some possible factors to increase readership that could include:

- Improve the quality and appearance of mailshots (Parker, 2002; Atwood, 2006)
- Personalise mailshots (Prime Litho Printing services, 2006) such as by designing case studies split by sectors (oil and gas, processing etc)
- Carry out further micro-segmentation selection to provide specific case studies to specific target clients only. This would be extremely time consuming. For a small company like Eatec with no initial background on segmentation or strategic marketing planning, should start off on an easier footing using convenient macro variables (Hague, 2002), which are generally easier to identify and access.

What this study has found through the analysis of question H, which looked at the client's perception on Eatec's level of skills and experience in solving complex engineering problems, was that the feedbacks were positive. This meant that the case studies had been successful in the communication of Eatec's competencies to target clients. Hence, the directors should continue with the case studies. The researcher felt that if the company were to continue with in-house design on marketing material, then an investment on specialised desktop publishing software such as Quark or InDesign, and indeed high quality printing facilities (or outsource the printing) would be beneficial. This would certainly improve the quality and appearance of the case studies (Parker, 2002; Atwood, 2006). The company should also consider employing a part-time marketing resource as a facilitator to the ongoing mailshot campaign and case study designs.

Whilst these are interesting findings, the researcher must stress that the success rate applied are specifically relevant to this case study only and thus are concluded as exploratory explanations and not definitive conclusions. The success rate is a constant figure that changes case-by-case, even for Eatec. There was insufficient time to carry out further studies, which would have been to find out on average the number of readership for every mailshot sent out, in order to develop a statistically significant readership success rate which could be applied more universally.

The mailshot effectiveness analysis concluded that time was a factor affecting the impact in recall success rate as results show below.

	Recall success rate	1st Mailshot	2nd Mailshot
Group 1:	0%	March 2003	July 2003
Group 2:	6%	April 2003	September 2003
Group 3:	6%	May 2003	September 2003
Group 4:	10%	June 2003	October 2003

Success rate	Criteria	Source
14%	Mailshot read	Analysis to question D
8%	Mailshot read Relevant to recipient	Analysis to question G
1%	Mailshot read Relevant to recipient Direct request for meeting or more information	Mailshot feedback slips

As a result of this finding, the researcher was able to formulate a simple formula to test future success rate. The crucial key questions in determining whether the mailshot effective was to understand if:

- 1) the mailshots were read
- 2) would they generate business leads

With the statistics gained from the mailshot questionnaire, the researcher was able to formulate a simple formula, assuming a readership success rate of 14% (findings gained from the mailshot effectiveness study carried out at the time where 50 mailshot were sent out, 7 were read).

This readership success rate gained from the mailshot effectiveness study (October 2003) can be expressed as:

$$(7/50)*100 \text{ or } (b/a)*100$$

a = how many mailshots sent

b = how many people reads it

$$c = \text{success rate} = (b/a)*100 = 14\%$$

If:

d = number of groups

e = the average* number of people in each group

(*an average number is used as number of people in each group may differ)

The total number of people is (d*e) or (de) in algebra terms. So to find out the number of potential clients to read the mailshots is (b/a)*100 of (de) the total number of people.

Thus the formula is:

$$(de)*((b/a)*100) \text{ or } (de)c$$

Table 6: Readership success rate formula

The researcher must stress at this point that 0.14, which is (c), *is the success rate found for this case study only*. It is a constant figure that changes case by case (even in Eatec) and so conclusions on readership success rate can only be generalised for Eatec only. The researcher found that for every 50 mailshots 7 were read. To develop a statistically significant readership success rate of (c), the researcher would need to carry out several studies highlighting '*for every mailshot sent, how many is read?*'. This would be a time consuming task and not one the researcher could do given the limited time and resource. It is recommended for further research to develop a statistically significant readership success rate benchmark to apply to (c), which could be used more universally to suit different managerial situations.

As the researcher has stated earlier in this chapter, although the knowledge that surrounded the variety of academic theories raised in this study was minimal for the requirements, it was seen to be vital to include enabling a better understanding of the research entirety. The researcher found that to increase the success rate (c): $c = (b/a)*100$ was to increase *a* and *b*.

Variable (a) can be changed by increasing the number of mailshots, but (b), how many people reads it, is dependent on finding out ‘what makes people read mailshots?’. This meant that the researcher needed to understand theories concerning marketing communications, its tools and their application.

There was insufficient time for the researcher to carry out such a study. However, it is a topic in its own right recommended for further research to run alongside this research, which predominantly focused on the evaluation and selection elements of segmentation. The aim would be to understand the concept of marketing communications and how it performs as part of the marketing mix in the business-to-business context of a small engineering firm.

The researcher did cover minimal theories and has listed some possible factors which could affect the readership success rate:

- Improve the quality and appearance of mailshots (Parker, 2002; Atwood, 2006)
- Personalise mailshots (Prime Litho Printing services, 2006) such as by designing case studies split by sectors (oil and gas, processing etc)
- Carry out further micro-segmentation selection to provide specific case studies to specific target clients only. This would be extremely time consuming and not recommended until Eatec’s segmentation programme has matured. In terms of experience and implementation, the segmentation programme is still at its infancy and so the directors would benefit from repeating the process a few times over the coming years to gain more experiential learning (Kolb, 1984).

References:

Abratt, R & Kelly, P.M. (2002). Customer–supplier partnerships, perceptions of a successful key account management program. *Industrial Marketing Management*, **31**, pp 467-476.

Attwood, T. (2007). *Raising response rates in direct mail*. Tony Attwood of Hamilton House Mailings plc [online]. Available from: Tony@hamiltonhouse.com [Accessed 1 July 2007]

AVS Group. (2007). *Highlight Your Business Success Stories with Marketing Case Studies* [online]. Available from: <http://www.avsgroup.com/resources/casestudies.asp> [Accessed 7 June 2007]

Bartels, R. (1967). A Model for Ethics in Marketing. *Journal of Marketing*, **31** (1), pp 20-26.

Beane, T.P. & Ennis, D.M. (1987). Market segmentation: a review. *European Journal of Marketing* **21**, pp 20-42.

Bonoma, T.V. & Shapiro, B.P. (1984). Evaluating market segmentation approaches. *Industrial Marketing Management*, **13**, pp 257-268.

Brace, I. (2004). *Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research*, London, Sterling VA.

Bryman, A. & Bell, E. (2004). *Business Research Methods*, Oxford University Press, Oxford.

CIM, The Chartered Institute of Marketing. (2007). *Workshops 2007*, One day marketing, sales & essential business training.

Clarke, A.H., & Freytag, P.V. (2005). *The relationship of product development and marketing in industrial segmentation*. 21st IMP-conference, Rotterdam, Netherlands.

Dibb, S. and Simkin, L. (1997). A program for implementing market segmentation. *Journal of Business and Industrial Marketing*, **12** (1), pp 51-65.

Dunn, M.G., Norburn, D. & Birley, S. (1994). The impact of organisational values, goals, and climate on marketing effectiveness, *Journal of Business Research*, **30**, pp 131-41.

Easton, V.J. & McColl, J.H. (1997). *Statistics Glossary*. [online]. Available from: <http://www.stats.gla.ac.uk/steps/glossary/index.html> [Accessed 2 March 2007]

Geisheker Group (2007). *How to get customer testimonials*. [online]. Available from: <http://www.marketing-consulting-company.com/marketing-testimonials.htm> [Accessed 7 June 2007]

Ghauri, P., Gronhaug, K., & Kristianslund, I. (1995). *Research Methods In Business Studies: A Practical Guide*. Padstow, Cornwall, Prentice Hall, Europe.

Ghosh, B., Schoch, H., Kwan, W., Kim, T. & Yau, O. (1993). Australia and Singapore's top performing organisations: a comparative study of their marketing effectiveness. *Journal of International Marketing and Marketing Research*, **18** (3), pp 115-139.

Goller, S., Hogg, A., & Kalafatis, S.P. (2002). A new research agenda for business segmentation. *European Journal of Marketing*, **36** (1/2), pp 252-271.

Hague, Paul. (2002). *Market Segmentation in B2B Markets* [online]. Available from: <http://www.b2binternational.com/whitepapers3.htm> [Accessed 18 July 2003]

Hunt, S.D., Chonko, L.B. & Wilcox, J.B. (1984). Ethical Problems of Marketing Researchers. *Journal of Marketing Research*, **21** (3), pp 309-324.

Kolb D.A. (1984). *Experiential Learning experience as a source of learning and development*, New Jersey, Prentice Hall.

Kotler, P. & Keller, K.L. (2005). *Marketing Management*, Upper Saddle River, NJ, Prentice Hall.

Lai, W.B., Huang, J.Y., Hooley, G., Lynch, J., & Yau, O. (1992). Effective marketing in Taiwan: profiles of the top performers. *European Journal of Marketing*, **26** (3), pp 5-17.

Malhotra, N.K. (2005). *Basic Marketing Research: A Decision-Making Approach (Second Edition)*. Georgia Institute of Technology, Mark Peterson - University of Texas at Arlington, Prentice Hall.

Meyers-Levy, J. & Peracchio, L.A. (1995). Understanding the Effects of Color: how the Correspondence between Available and Required Resources Affects Attitudes. *The Journal of Consumer Research*, **22** (2), pp 121-138.

Mouzas, S. (2006). Efficiency versus effectiveness in business networks. *Journal of Business Research*, **59** (10/11), pp 1124-1132.

Norborn, D., Birley, S., Dunn, M. & Payne, A. (1990). A four nation study of the relationship between marketing effectiveness, corporate culture, corporate values, and market orientation. *Journal of International Business Studies*, **21** third quarter, pp 451-68.

Palmer, R.A. & Millier, P. (2004). Segmentation: Identification, intuition and implementation. *Industrial Marketing Management*, **33** (8), pp 779-785.

Parker, R.C. (2002). *Guerilla Marketing & Design: Profiting from testimonials*. [online]. Available from: www.gmarketing.com **4** (3) [Accessed 23 August 2007]

Payne, A. (1988). Developing a marketing oriented organisations. *SoM Working Papers 40/88 SWP* [online]. Available from: <http://hdl.handle.net/1826/387> [Accessed 9 January 2006]

Pretty J.N., I. Guijt, J. Thompson & I. Scoones, A. (1995). *Participatory Learning and Action: A Trainer's Guide*. International Institute for Environmental and Development.

Prime Litho Printing Services, members of Direct Marketing Association. (2006). *Personalising direct mailshot*. [online]. Available from: <http://www.primelitho.co.uk/solutions.htm> [Accessed 2 July 2007]

Webster, F.E. (1991). *Industrial Marketing Strategy*, John Wiley & Sons, New York, NY.

Webster, C. (1995). Marketing culture and marketing effectiveness in service firms. *Journal of Services Marketing*, **9** (2), pp 6-21.

Weinstein, A. (1987). *Market Segmentation*, Probus Publishing, Chicago, IL.

Wengler, S., Ehret, M. & Saab, S. (2006). Implementation of Key Account Management: Who, why, and how? An exploratory study on the current implementation of Key Account Management programs. *Industrial Marketing Management*, **35**, pp 103-112.

Wittink, D. R. & Cattin, P. (1989). Commercial Use of Conjoint Analysis: An Update. *Journal of Marketing*, **53** (3), pp 91-96.

Yu, J. & Cooper, H. (1983). A Quantitative Review of Research Design Effects on Response Rates to Questionnaires. *Journal of Marketing Research*, **20** (1), pp 36-44.

Zolkiewski, J. & Turnbull, P. (2000). *Relationship Portfolios – Past, Present, Future*. 16th IMP conference, Bath, UK.

Zolkiewski, J. & Turnbull, P. (2002) Do relationship portfolios and network provide the key to successful management? *Journal of Business & Industrial Marketing*, **17** (7), pp 575-597.

Content of Tables:

	Page no
Table 1 Questionnaire design - content of questions and actual wording	14
Table 2 Questionnaire design – possible questions posed to researcher by the respondent	15
Table 3 Mailshot effectiveness analysis questions A to C3	23
Table 4 Mailshot effectiveness analysis questions D to F	24
Table 5 Mailshot effectiveness analysis questions G to I	25
Table 6 Segments of the Zolkiewski and Turnbull (2000) Matrix	46
Table 7 Illustration of how Zolkiewski and Turnbull's and (2000) Matrix can be used in Eatec's situation	47

Content of Figures:

	Page no
Figure 1 Mailshot planner developed for the implementation stage	3
Figure 2 Steps to designing a questionnaire (Malhotra, 2005)	9
Figure 3 Questionnaire design - arranging the questions in order	20

Appendix:

- 1 Journal review
- 2 Draft PR Strategy
- 3 New Eatec Advertisement
- 4 Eatec ExTRACT brochure

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Rail	Railway Gazette International	Monthly 1,525 UK (ABC)	railway management, railway operators and suppliers	Small~ 200 Medium~ 400 Large~ 600 Reports~ 1000	Engineering & design consultancies Equipment suppliers	Yes	Useful for Eatec to publish in but we may not benefit from the wider circulation as we are not targeting that wide at the moment. There's a conference for 'commercial & technical strategies for implementing new signalling technology'. & A 'three day rail technology congress with special focus on: noise, vibration and environment' Maybe useful?
Rail	International Railway Journal	Monthly- 1 st of month 1,224 UK (BPA) See brochure for breakdown of business/occupational analysis	principal officers of railways of the world, ministers and commissioners of transport, railway equipment manufacturers and suppliers	Small~ 150 Medium~ 550 Large~ 900 Reports~ 1300	Industry suppliers Designers and manufacturers of transport seating Exhibitions & conference management Suppliers of vibration control systems	Yes, but there is a large emphasis on international development, particularly with the major Asian expansions. Perhaps not suitable for Eatec at this stage.	Eatec would certainly gain wider coverage in this publication. In Europe alone, total circulation is 5092, in US 719.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
General Engineering	Essentials for Industry	<p>6 issues yearly- pub. 3rd wk of 1st mth</p> <p>The publication is sent to the most active 15,000 people from the publications respondents.</p> <p>Job function highlights:</p> <p>31.3% are in engineering</p> <p>26.6% in top management</p> <p>Industry highlights of relevant to Eatec:</p> <p>Aerospace 5.1%</p> <p>Paper & Board 1.15</p> <p>Food, drink & tobacco 5.7%</p> <p>Mechanical engineering 21.3%</p>	Directors, Managers, and mechanical production, maintenance, and work engineers	<p>Small~ 100-150</p> <p>Medium~ 250</p>	<p>Anyone in industry.</p> <p>Roofing</p> <p>Packaging</p> <p>Oven suppliers</p> <p>Tools for the trade</p>	Yes but its audience is very diverse.	

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
General Engineering	Essentials for Production	<p>6 issues yearly- pub. 3rd wk of 1st mth</p> <p>The publication is sent to 10,000 production executives from the publications respondents.</p> <p>Job function highlights:</p> <p>47.6% are in production engineering</p> <p>Industry highlights of relevant to Eatec:</p> <p>Aerospace 4%</p> <p>Mechanical engineering 25%</p>	Directors, managers, engineers and purchasing officers within production	<p>Small~ 100-150</p> <p>Medium~ 250</p>	<p>Anyone in industry.</p> <p>Machines in production activity</p>	Yes	
General Engineering	Plant & Works	<p>monthly- pub. 3rd wk of the mth</p> <p>Total 19,641 (publishers own data)</p>	engineers and plant mgrs in commercial, industrial and government bodies who purchase equipment	<p>Small~ 100-200</p> <p>Medium~ 500</p> <p>Report~ 800</p>	<p>Industry suppliers.</p> <p>Pallet and package handling systems.</p> <p>Service and repairs.</p> <p>Computer aided maintenance & analysis.</p>	Yes. But there are very little if any, engineering consultancy advertisements.	

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
General Engineering	Design Engineering	Monthly 16,518 worldwide	Engineers, Targeted to companies with over £1m turnover Targeted in the OEM sector of UK manufacturing.	Small~ 150 Medium~ 270 Large~ 1100	Anyone in industry. Equipment suppliers Engineering recruitment	Yes	Surprised to see no advertisements from engineering consultants. Quite general.
General Engineering	Professional Engineering	Monthly 15, 256	senior process & chemical engineers employed in UK process industries	Small~ 150 Medium~ 250-280 Large~ 650-1000	Equipment suppliers Engineering Analysis Product development. FE Analysis. Engineering analysis. (Eatec advertisement)	Yes	General. No specific targets to a particular industry. This publication will help us to target a wider general audience dealing with engineering problems.
General Engineering	Environmental engineering	Print every quarterly, March, Jun, Sept, Dec. Approx 7,000	Directors, Managers, and mechanical production, maintenance, and work engineers	Small~ 200 Medium~ 500 Large~ 1000	Vibration services, Engineering consultancies Reliability specialists	Yes	Our Ad is in there. Covers defence testing, aerospace testing, auto testing. Relevant for us to place PR in there.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
General Engineering	What's new in industry	Monthly 33,685 (UK0 ABC	New productive development in manufacturing. Buyers.	Small~ 100- 50 Medium~ 250 Large~ 1000	Equipment suppliers Service providers Engineering recruitment Plant maintenance	Yes	As we are more interested in placing articles based on application of engineering techniques to problems, this might not be a good publication to target. Unless the problem we dealt with in industry is unique or a new problem, then might raise some interest. Generally, it's just a guide to new products and equipments.
General Engineering	The Engineer	Weekly 36, 593 ABC	engineers & senior exec in technology-led sectors	Small~ 150 Medium~ 600 Large~ 1000-1200	Equipment suppliers Service providers Engineering recruitment Simulation and engineering consultants.	Yes	news, comment & analysis on business, innovation & technology across all UK manufacturing business. Management stories.
General Engineering	Eureka	Breakdown of circulation on: Audit Bureau Circulation website	senior design mgrs and technical directors in the manufacturing industry	Small~ 150 Medium~ 500-600 Large~ 1000	Simulation and engineering consultants.	Yes	examples of innovative engineering design together with materials technology advances

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
General Engineering	Plant & control engineering	monthly- pub 21st of mth 16, 781 UK 127 Other countries (ABC) including engineers, operations, process and maintenance, design and R&D. Consultants.	plant and control engineers and production mgrs	Small~ 100-150 Medium~ 180 Large~ 1200	Equipment suppliers, Solution consultants,	Yes	They have a problem solvers section, very applicable to Eatec. Page 12 is similar to what we would want to do in a press release. (pg 31- advertisement for vibration monitors) In the back there is a buyer's guide. Most adverts are placed throughout the publication.
General Engineering	Engineering	monthly- 1st wk of month 22,618	Senior exec & engineers in manufacturing industries, nationalised industries, and construction	Small~ 150 Medium~ 450 Large~ 1000-1500	Equipment suppliers, Mechanical engineers, FE consultants Simulation software	Yes	There was a free exhibition and conference on 12-13 February for medical device and technology field. There was also a list of attendees which we may be able to use. There is another engineering exhibition and conference in May based on innovation in technology, manufacturing and management. There's also a section on rail engineering. It's an engineering publication and covers a number of sectors for a wider target. Quite a think magazine as well.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
General Engineering	Production Engineering	13 issues yearly	Production mgrs, engineers	Small~ 150-160	CAE people, deep hole	Yes.	Reporting on new machine tools and tooling, innovative CAD/CAM

	Solutions	16, 480 ABC	and senior buyers	Medium~ 400-500 Large~ 1000	drilling, drilling machine manufacturer, gear cutting services, production engineering related.		technology and applications in the metal working industry.
General Engineering	Polymer Engineering	10 issues yearly 20,000 publishers statement	People involved in the plastics and rubber industry	Small~ 120 Medium~ 160 Large~ 1000-1500	Recruitment people, print solution for product decoration, mould making people, manufacturers,	Yes.	Provides in depth features and technical information about the plastics and rubber moulding industry. In Sept, they are doing a feature on testing and monitoring. Looks very relevant to Eatec.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
General Engineering	Design Products and Applications	monthly- pub in 2nd wk of mth 26,716 UK 55 Other countries (ABC)	plant and control engineers and production mgrs	Small~ 100 Medium~ 150-170 Large~ 400	Equipment suppliers, Solution consultants,	Yes	Feels like another engineering magazine.
General Engineering	Engineering Technology	11 issues yearly 40,000	Members of the Institution of Incorporated Engineers and engineers in electronic, electrical and mechanical engineering	Small~ 160 Medium~ 250 Large~ 900-1200	Design engineers Equipment suppliers	Yes	The issues in the publication seemed more relevant to Eatec than the DPA. But the audience would really be general engineers and not really targeting to our chosen markets.
Aerospace	Overseas Trade: Aerospace	Monthly 29,198		Medium~ 600 Large~ 1200	Trade missions Exporters Airline companies	yes	Too specialised for Eatec and articles would not benefit in this publication.
Aerospace	Aerospace International	Monthly: 25th 26,742 BPA	Qualified aeronautical engineers, pilots and maintenance engineers.	Mainly large articles	Lots of recruitment adverts.	Yes	Covers royal aeronautical society, industry news, general features on aviation, defence, safety, air transport and spaceflight articles. Not sure where we would fit in. Not that relevant.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Aerospace	Aerospace Testing International						Spoke to a guy called Rodney Jenkins. He will contact Brian Williams direct.
Automotive	Automotive Engineer	11 issues yearly 10,043 UK publisher's statement	Engineers, executives and managers in the automotive industry.	Small~ 100 Large~ 1500	Engineering consultants, designers.	yes	The magazine covers research, developments, engineering components, new designs, testing, electronics and manufacturing. This is a very relevant magazine. They have stories and case studies showing applications of services.
Automotive	Tire technology International	Quarterly: March, June, Sept, Dec. 6,010 ABC	Senior executives and managers responsible for operations and capital investment programmes. CE, plant and production directors, chemists, compounders, engineering mgrs, R&D Mgrs, buyers & consultants in every tire manufacturing plant in the world.	Small~ 100 placed at the beginning of the magazine. Large~ 1000-1500	Engineering consultants Chemical people, Machinery suppliers,	Yes	Talks about tire designs, manufacturing and production technology. It's very relevant. There is a case in this months issue talking about modelling methods and how much it's become more appreciated in recent years.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Automotive	Engine Technology International	Quarterly: March, June, Sept, Dec. 12,000 throughout global automotive.	Chief and Principal Engineers, technical Directors, R&D Directors, Design Engineers, Production Directors, Product and Project Managers, Purchasing Managers.	Small~ 100 placed at the beginning of the magazine. Large~ 1000-1500	Engine people, Engineering consultants,	Yes.	Case studies, industry figures, product reviews, technology features and engine appraisals. Lots about application of techniques and services. Very relevant,
Automotive	Automotive Manufacturing Solutions	Quarterly: around 28 th each month	OEMs, engineers and people within the automotive manufacturing industry worldwide.	Small~ 100-150 Mainly large articles~ 1000-1500	Manufacturers, Noise and vibration production test system. Engineering consultants,	yes	Covers all aspects of automotive manufacturing including welding, laser plants and robotics.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Defence	Defence Systems International 2002	Half yearly- published in Spring and Autumn 14,000	military leaders, procurement managers and technical chiefs	1 pg~ 700 full article~ 2000	People who sell defence products, i.e. handgrenades, Vehicles, helmets, radar, satellite	Yes	Not really Eatec's area.
Processing	Biscuit World	globally- quarterly- middle of cover month UK- 622 USA- 789	biscuit producers, producers of ingredients and those involved to any degree in the process of biscuit manufacturing	Small~ 100-120 Medium~ 350-380 Large~ 1500	Machine suppliers, Biscuits formula	Yes	Not really relevant looking at the current advertisers, but it may be to our advantage if we can demonstrate how engineering techniques can be applied to processing problems in the baking industry.
Processing	European Baker	Monthly UK- 1690	Large biscuit, cakes, morning goods and other related products. producers of ingredients and those involved to any degree in the process of biscuit manufacturing	Small~ 150-180 Medium~ 350 Large~ 1000	Machine suppliers, Food processing suppliers, Technical consultancy Processing experts,	Yes	Again, not really relevant looking at the current advertisers, but it may be to our advantage if we can demonstrate how engineering techniques can be applied to processing problems in the baking industry. There was only one advertisement for technical consultancy.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Processing	Confectionary Production	<p>monthly- published on 20th</p> <p>3,500 people throughout the world take out a paid annual subscription.</p> <p>13,500 readerships, where 1 copy circulates to at least four individuals.</p> <p>Based on this, circulations is:</p> <p>UK- 41% Worldwide- 30% Europe- 29%</p>	<p>Readers fall into the categories:</p> <p>Cocoa, Chocolate, Sugar, Confectionary, Ice cream and Bakery.</p> <p>Directors- 24.4% Managers- 15.4% Works & Devt. Engineers- 24.1% Research & Quality Control Chemists- 5.3% Salesmen/Buyers- 11.8% Other personnel- 19%</p>	<p>Small~ 150</p> <p>Medium~ 300</p> <p>Large~ 450-500</p>	<p>Machinery suppliers,</p> <p>Ingredient producers,</p> <p>Industry consultancy: more advisory such as development and improvement and factory design, rather than technical consultancy.</p>	Yes	<p>It's easier to read than the other processing publications.</p> <p>I can see that we could have an article in there under 'equipment news'. As they also have small case studies, about half a page with pictures describing how a software or system has enhanced production or solved a problem.</p>
Processing	Bake and Take	<p>Monthly</p> <p>6,502 ABC</p>	<p>Craft and industrial bakers and confectioners.</p>	<p>Small~ 150</p> <p>Medium~ 500-600</p> <p>Large~ 800~100</p>	<p>Oven suppliers, installation, food equipment, Bakery computing, packaging people,</p>	Yes	<p>A monthly journal for bakery, takeaway and food service.</p> <p>Covers news and baking technology and case studies.</p> <p>We could make use of this case study style.</p>

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Processing	Food Processing	Monthly- 20th 8,614 ABC	Decision makers in the food processing industry	Small~ 100 Medium~ 150-200 Large~ 1000-1500	Mixing technology experts, Project and construction consultants,	Yes	It covers technical news, product info, features, packaging, hygiene, distribution and process control, financial and business issues. Lots of advertising, little article, just a few main reports on trends, issues faced in the market.
Processing- food and packaging	Food marketing and manufacturing	Monthly 10,219 publisher's statement	Management in the food processing industry	Small~ 100 Medium~ 350-400 Large~ 800-1000	Machine suppliers,	Yes, It's quite an easy to read journal. Lots of small articles and certainly caught my attention to read more than the other journals.	Contains reports and company profiles covering food manufacturing process. Covers new techniques and innovations across a spectrum of food processing, packaging, marketing and retailing sectors. The same press release was placed in the food trade review but worded slightly differently.
Processing- food and packaging	Food Trade Review	Monthly 5,190 publisher's statement	Production and technical managers in food manufacturing and processing companies	Small~ 100 Medium~ 350-400 Large~ 800-1000	Machine suppliers, Packaging equipment	Similar to the food marketing and manufacturing journal. Lots of small articles and very easy to ready.	News about latest methods and techniques of food processing and manufacturing and trade news.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Processing	Package, Print and Converting	6 issues yearly 8,000 publisher's statement	Package buyers, graphic designers, technicians, technologists and people working in repro origination, package printing, industrial equipment and supply.	Small~ 150-200 Medium~ 550 Large~ 1000	Printers, Machinery providers, manufacturers	yes	Talks about print on packaging for the food and drink, pharmaceutical and cosmetics industries. They have a section on customer case study which is relevant to something we want to do. (pg 34).

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Processing	Machinery Update	6 issues yearly- pub. 1st wk of 1st mth 10,000	Manufacturers of food, pharmaceuticals, cosmetics, toiletries & drinks, confectionary, snacks, household, hardware and chemicals. Readers look to specify and purchase processing and packaging machinery.	Small~ 100 Medium~ 250 Large~ 1000	Packaging machinery, Equipment suppliers, Labelling providers,	Yes	The adverts in there are mainly targeted to people who are looking to buy new equipments, but there are no directory's for people to turn to if a machine goes wrong. It looks like if anything goes wrong with the machine, the users turn to the manufacturers of the machine.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Processing	Process Engineering	11 issues yearly 2nd wk of mth 15, 245 (UK) ABC 489 (Other countries)	senior process & chemical engineers employed in UK process industries	Small~ 150-160 Medium~ 300 Large~ 1000-1500	Industry system suppliers /services 'solution experts' have a product to handle, solve problems. Specialist flow measurement engineering Engineering recruitment.	Yes	Again no engineering consultancies advertising in there. The quality of the magazine is not as nice as the other ones and difficult to read as pictures and articles are all over the place.
Processing	Food Technology & Packaging	Quarterly 7000	Aimed at trade in food processing, packaging and related industries. Well known in UK technological and manufacturing sectors.	Small~ 120 Medium~ 500 Large~ 700	Industry system suppliers /services 'solution experts' have a product to handle, solve problems. Specialist flow measurement engineering Engineering recruitment.	Yes	It's A3 size, colourful and big! They have a page called product news where company describes their products, advantages etc, and telephone contact, so partly advertising too. Our case study might fit in well in there.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Processing	Barry Wilson's Dairy Industry Newsletter	25 issues yearly 1000	technical and management personnel in processing, dairy	Small~ 100 Medium~	No one, but you can advertise in it if you like.	Yes	Too specialised!

			and ice-cream plants in the UK	200 Large~ 400			
Processing	Dairy Industries International	Monthly 6,167 ABC	Aimed at international processing industry	Small~ 200 (font is a bit smaller than the other magazine. Medium~ 600 Large~ 1200	Manufacturers, Engineers and designers,	Yes	It talks about technology within the dairy industry which is what Eatec could make use of, but we would have to word it so that the dairy people can relate to it.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Processing	Glass Technology	6 issues yearly 1,100 publishers statement	Managers in the glass manufacturing industry, academic researchers and others working in the industry.	5-7 page papers	No one	yes	These are research papers. Whilst they are useful to people working in the glass industry, It's not the kind of publication we should spend time on as too academic.
Processing-plastics and rubber	Polymers for advanced technologies	Half yearly 400 print run	Industrial and academic scientists & engineers in the fields of materials science, polymer science, organic chemistry, biochemistry, chemical, plastics and, mechanical engineering, biotechnology, molecular modelling & design.	7 full pages journal paper	nobody	The journals are very specific. Although the articles do target the audience stated, it's not really one which we would benefit from by putting our case study in there.	Too academic!
Processing-plastics and rubber	British plastics and rubber	11 issues yearly 14,178 ABC	Managers with specifying and purchasing influence.	Small~ 100-120 Medium~ 200 Large~ 2400	Consultants, Testing & consultancy, Product design, Moldflow analysis	yes	Looks relevant. It covers technical news of the plastics and rubber processing industry. A section on software review.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Processing	International Paper Board Industry	Monthly 10,700 publisher's statement	Production managers and plant managers	1500	Machinery manufacturers, Materials handling systems, cardboard packaging suppliers,	yes	The magazine covers news, trade and developments in the corrugated packaging industry. A good magazine for us to talk about the SCA case study in.
Processing	Packaging today international	Monthly 12,655 ABC	UK and European packaging industry	Small~ 100-120 Large~ 1000	Packaging people/designers, Plastic packaging	yes	Contains news and features on all aspects of the packaging industry.
Processing	Paper Making and Distribution	8 issues yearly 6,800 publisher's statement.	People connected paper and pulp industry	Small~ 100 Medium~ 500 Large~ 1000-1500	Rail logistics, web technology solutions, Software solutions, Core cutting, freight,	yes	Interesting magazine about the paper industry esp. pg 6, about decreasing UK paper market. Pg. 32 talks about 'Wheels that keep paper reels turning', interesting article about the challenges paper makers face with more demanding clients requiring shorter lead times. Yes, relevant to us!
Processing-Clothing and textiles	Textile Month	monthly 10,000 publisher's statement	Management level, textile industrialists	Mainly large articles~ 1000 up	Cotton, People selling materials, textiles, Machinery suppliers,	Yes but it's not really our market	Covers the machinery and processes involved in the manufacture of textiles, from fibre through to finished product.

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Oil and Gas	Offshore Engineer	Monthly 18,198 USA 9,991 Europe (BPA) There is a good breakdown of its circulation including by job function, company, and personal area of activity, and by geographic region.	operation mgrs and engineers in oil and gas organisations, supply companies and main and sub contractors	Small~ 100 Medium~ 250 Large~ 1800	Engineering consultants. Industry equipment suppliers,	Yes	Reports are very long. More industry news. Not so relevant.
Oil and Gas	World Pipelines	6 issues yearly 10,048 ABC	Pipeline engineers and contractors, purchasing officers, technical directors, plant managers, environmental specialists, process engineers, equipment suppliers and sales managers.	Report~ 1600-2000	Pipeline management Manufacturers, Valves Project management Drilling	Yes	Editorial very interesting and relevant to our work. We could get into the Oil and Gas industry, not in drilling but in areas such as pipelines etc. The magazine covers all aspects of the oil and gas pipeline industry, including global news, reports, developments with new contracts and tenders, economic and technical features. Relevant!

Industry	Publication title	Circulation figure	Target audience	size of a typical article	who is advertising in it?	Does this indicate target readers?	Comments / Interests
Construction	Concrete	10 issues yearly 7,000 publisher's statement	Consulting engineers, contractors, construction equipment and material manufacturers, and suppliers.	Medium~ 1000 Large~ 2000-2500	Engineering consultants. Industry equipment suppliers,	Yes	It's a specific market but maybe Eatec could develop a market here. i.e., out work on cladding?? On pg 40 of Feb 2003, vol 37 no 2, a special report on recast cladding.
Construction	Concrete Engineering International	quarterly 5,395	Specifiers, engineers, contractors and suppliers.	Small~ 500 Medium~ 1000 Large~ 2000-2500	Engineering consultants. Industry equipment suppliers,	Yes	More specific and covers international issues. The other magazine 'Concrete' was better for Eatec to target.
Mining and Quarrying	Mining Magazine	Monthly 12,819 ABC	Contains product and processing updates, literature comments, mining coverage and exploration equipment reviews.	About two or three main articles.	Engineering consultants, Environmental management, Machinery suppliers	Yes,	Good article on US mining technology. Talks about drilling rock bits, but are we allowed to develop business here??

PR Plan- Draft

PR Objectives

- To increase awareness of Eatec.
- To be perceived as providers of a range of advanced analytical/testing services.
- To be perceived as experts in particular industries/fields.

Measurement of Success

The success of the PR campaign would be evaluated according to:

- The quantity of press coverage in target publications.
- The number of qualified contacts added to the Company database.
- The monitoring of sales and enquiries resulted from specific pieces of articles/releases.

Strategy

- Generate a series of small articles which highlights Eatec's engineering services applied to particular engineering problems faced in industry. Targets: 8-9 articles and release to a number of publications.
- Generate ideas for large articles.
- Identify target publications.
- Establish relationship with editors.
- Establish publication's editorial plans and deadlines.
- Generate large articles relating to the development of techniques or case studies of Eatec's clients who had experienced benefits as a result of implementing Eatec's engineering solutions. Produce and issue these to target publications. Targets: 5-6 case studies in 2003.

Suggested large articles for publication

- Analysis of roofs. Developed techniques to determine roof thermal performance. Suitable for publication called- Roof, Cladding & Insulation
- Prediction of rubber properties. Suitable for publications involved in:
 - Rubber
 - Mathematical Modelling Journal
 - Professional Engineer
- Rock Mechanics (fracture mechanics of rocks). Suitable for publications like Journal of Petroleum Technology. May need approval from client.
- Visualiser work such as design of software package for Reed Hycalog. The benefit of the software is that it displays predictive behaviour of drill or test results. Will need approval from client.
- Guinness Transportation (Package and Handling). Will need approval from client.

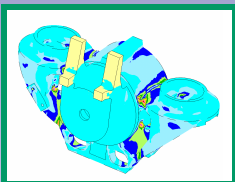
Ideas for small articles

- Signed 3 year research contract with Reed Hycalog and mention work that will be involved.
- Winning a craft grant for rubber project.
- Database- test results, first sale of tailored product.
- Mathematical Modelling- How it can help you!!!!



ENGINEERING
CONSULTANTS

ACHIEVING EXCELLENCE IN ENGINEERING

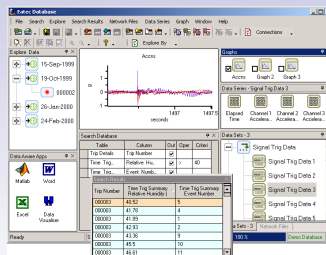


TESTING
DYNAMIC ANALYSIS
SHOCK ANALYSIS
THERMAL ANALYSIS
SIMULATION / PREDICTION
ADVANCED DATA MANAGEMENT TOOLS

Contact us at:

3 Armstrong Court
Armstrong Way, Yate,
Bristol BS37 5NG.
Tel: 01454 332240
Fax: 01454 332249
Email: enquiries@eatec.co.uk

www.eatec.co.uk



The Challenges

Engineering and scientific organisations operating test or production facilities frequently generate huge quantities of data. The data recorded can also vary enormously in its type, from acceleration and temperature histories to stress strain curves or condition monitoring.

All too often the required information is extracted from the data at the time of the test. The data is then lost or not archived properly; loss of key information such as the placement and calibration of sensors can render data useless.

What happens if, in 6 months time, the data is needed again?

How would an engineer be able to identify that a test with the right characteristics had already been performed?

You could with Eatec's
EXTRACT...

www.eatec.co.uk

Services include:

- Analysis
- Prediction
- Simulation
- Testing
- Research
- Failure Assessment
- Software Development
- Transport monitoring

Eatec is an independent UK company which specialises in the provision of engineering services to clients who are engaged in the development of new products, resolution of engineering problems, undertaking research or managing test and other scientific data.

Expertise in:

Finite Element Analysis (FEA)
Computational Fluid Dynamics (CFD)
Mathematical Modelling
Neural Network Modelling
Dynamic Testing
Signal Processing

Address

3 Armstrong Court, Armstrong Way, Yate, Bristol. BS37 5NG.

E-mail: info@eatec.co.uk

Tel: + 44 (0) 1454 332240

Fax: + 44 (0) 1454 332249

ACHIEVING EXCELLENCE IN ENGINEERING

eattec

Unlock Your Data

eatec
ENGINEERING

ExTRACT

Eatec's Test Results Access & Classification Tool



Applications- in the areas of:

- Test
- Research
- Product Design
- Development
- Machine & System Maintenance
- Environmental Monitoring
- Structural Analysis

Key Features

- Secure archive of data and summary information
 - The use of any proprietary database such as Oracle, Microsoft SQL Server or Microsoft Access gives easy and robust handling of data with control of security and replication
- Organised storage of test and summary information pertinent to each test gives multiple users access to the same data
 - EXTRACT can be configured to use any proprietary database, resulting in a highly flexible system
- Searching and retrieval of data
 - The advanced query facility allows users to search for trends in data
 - Retrieved data can be plotted for reporting and comparison
- Post processing of retrieved data
 - Seamless integration with third party post processing and reporting packages such as Word, Excel and Matlab
 - Use of plug-ins for bespoke post processing

Overview

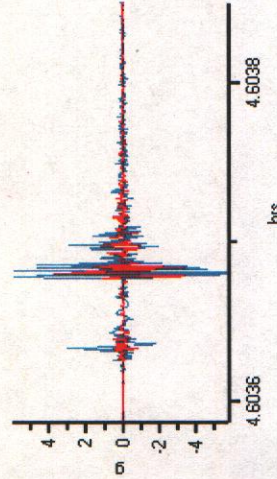
Eatec's EXTRACT is a state of the art data storage, search and retrieval application. The graphical user interface accesses a database where the data and appropriate summary details are stored. Input to the database is via a universal file loader; if not in the universal format, a custom loader can be provided to convert the data.

The database can contain any type of data in any kind of structure, giving maximum flexibility. Eatec must first assess the clients data and determine how best to generate summary parameters which characterise the data. The database is then designed to meet the requirements.

The search facility enables complex queries and gives the user an efficient way of finding and comparing data sets. EXTRACT will be of use not only for test engineers, but also for designers, stress engineers and for maintenance/monitoring activities.

Benefits- efficient locating and access to data for:

- Service conditions
- History of failures
- Fatigue life data
- Comparison of results & measurements
- Trends, means and maxima/minima for critical parameters
- Transfer of results into formal reports



Data

Loading

Both historical and current data are loaded into the database via the universal file loader. The loading process can be fully automated.

Summary parameters are stored in the database and enable the user to search efficiently. They are calculated at the data loading stage. The parameters are typically of three types:

- test descriptors such as test data, engineers name and project number,
- statistics of the data channels such as min, max and rms values and
- processed parameters such as efficiency and power output.

Data Searching

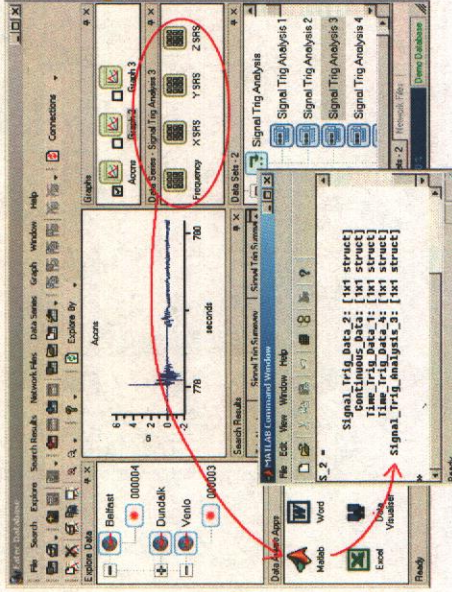
All summary parameters can be searched, including the processed values. For instance, all tests performed on a particular system by 'Peter Smith' where the maximum rpm reached 2000rpm and the efficiency was greater than 76% can be found very easily.

Where there is a vast amount of data, searching for characteristics by more traditional means quickly becomes a time consuming and tedious task.

Once the data of interest has been identified and viewed as required, EXTRACT can export graphs to Word for reporting and data to Excel or Matlab if further post-processing is required.

Data Export

In certain circumstances the user may have in-house post-processing tools. These can be linked to EXTRACT to allow export via a simple drag and drop operation.



Trip Number	Trip Code	Signal Trig Peak X Acceleration (g)	Signal Trig Peak Y Acc
000004	BT	3.79	5.3
000004	BT	3.2	3.96

Table	Column	Operator	Criteria
Trip Details	Trip Number		
Trip Details	Trip Code		
Signal Trig Summary	Peak X Acceleration (g)		>
Signal Trig Summary	Peak Y Acceleration (g)		>

BT	2.08	-2.45
BT	-3.67	18.34
BT	2.31	-1.33